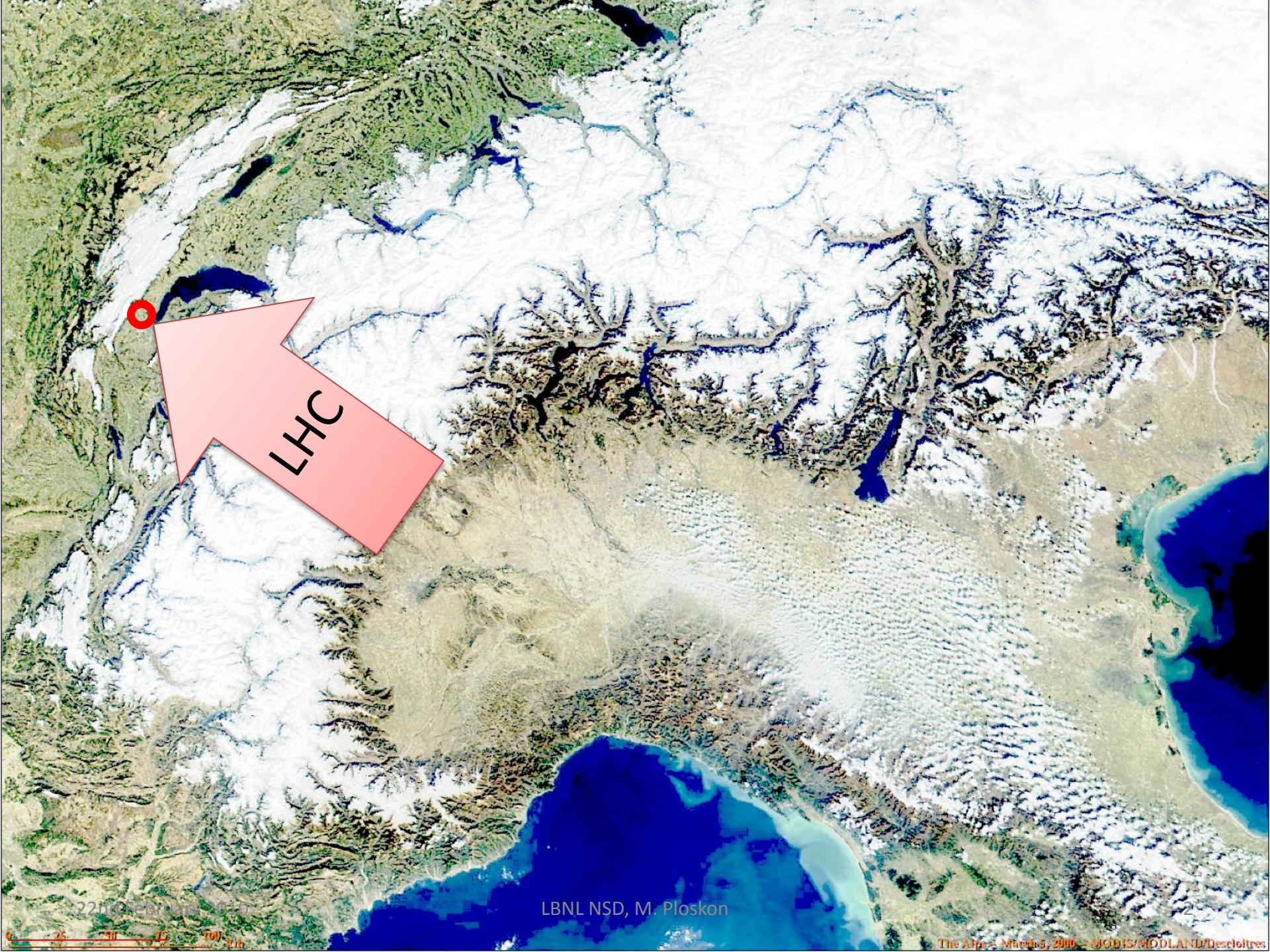
First results from ALICE at the LHC

http://www.youtube.com/watch?v=ZOJvgatf2VY

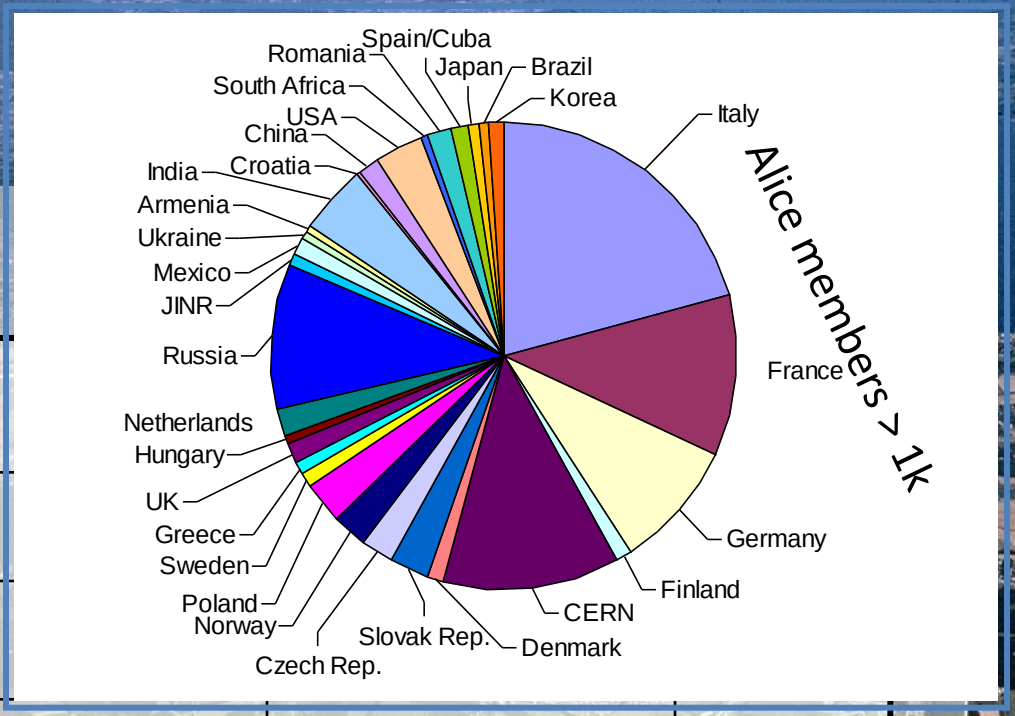
http://www.youtube.com/watch?v=UlhV7LFjloQ


LHC


Alice

LHC

Collision system	$\sqrt{s_{NN}}$(TeV)			
pp	14.0			
PbPb	5.5			
pPb	8.8	10^{29}	10^{6}	1.9
ArAr	6.3	10^{29}	10^{6}	2.7



Alice

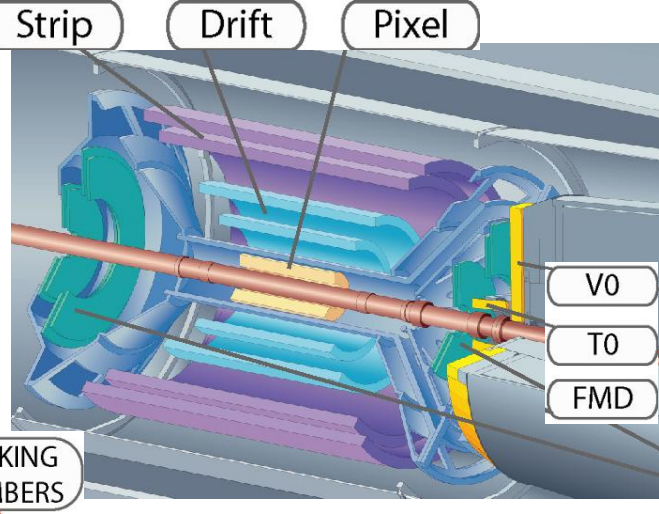
$^{*}\mathcal{L}_{max}$ (ALICE) = 10^{31}

$^{**}\mathcal{L}_{int}$ (ALICE) ~ 0.5 nb^{-1}/year

- + other ions (Sn, Kr, O) & energies (e.g.: pp @ 5.5 TeV)

Size: 16 x 26 meters
Weight: 10,000 tons

ALICE



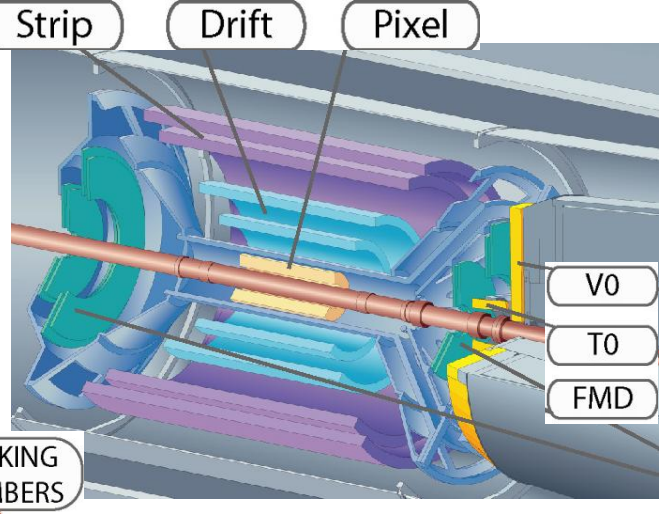
ACORDE
ITS
FMD T0 & V0
EMCAL
TRD
HMPID
TRACKING CHAMBERS
PMD
ZDC ~116m from I.P.
MUON FILTER
V0
T0
TPC
TRIGGER CHAMBERS
ZDC ~116m from I.P.
TOF
PHOS
DIPOLE MAGNET
ABSORBER

Technologies:18

Tracking:	7
PID:	6
Calo. :	5
Trigger, N_{ch} :	11

Size: 16 x 26 meters
Weight: 10,000 tons

ALICE



ACORDE
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EMCAL
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TOF
PHOS
DIPOLE MAGNET
ABSORBER

Technologies:18

Tracking:	7
PID:	6
Calo. :	5
Trigger, N_{ch}	:11

Almost to the day, 19 years ago..

Minutes of the 1st meeting on heavy ion / pp min. bias physics at LHC

The following is a short summary of the presentations and discussions taking place during the first meeting on a Heavy-Ion-Experiment at LHC held on Thursday 13.12 1990 at CERN. The intention of this meeting was to initiate a ser... heavy ion detector capable of meas-uring ultra-relativistic heav... atte... s attended by over 60 physicists. Copies of the transparencies and ... o the participants as annex to these minutes by mail.

'Fast Forward'
to…
November 23rd 2009

experimental areas will be finalized by end '91

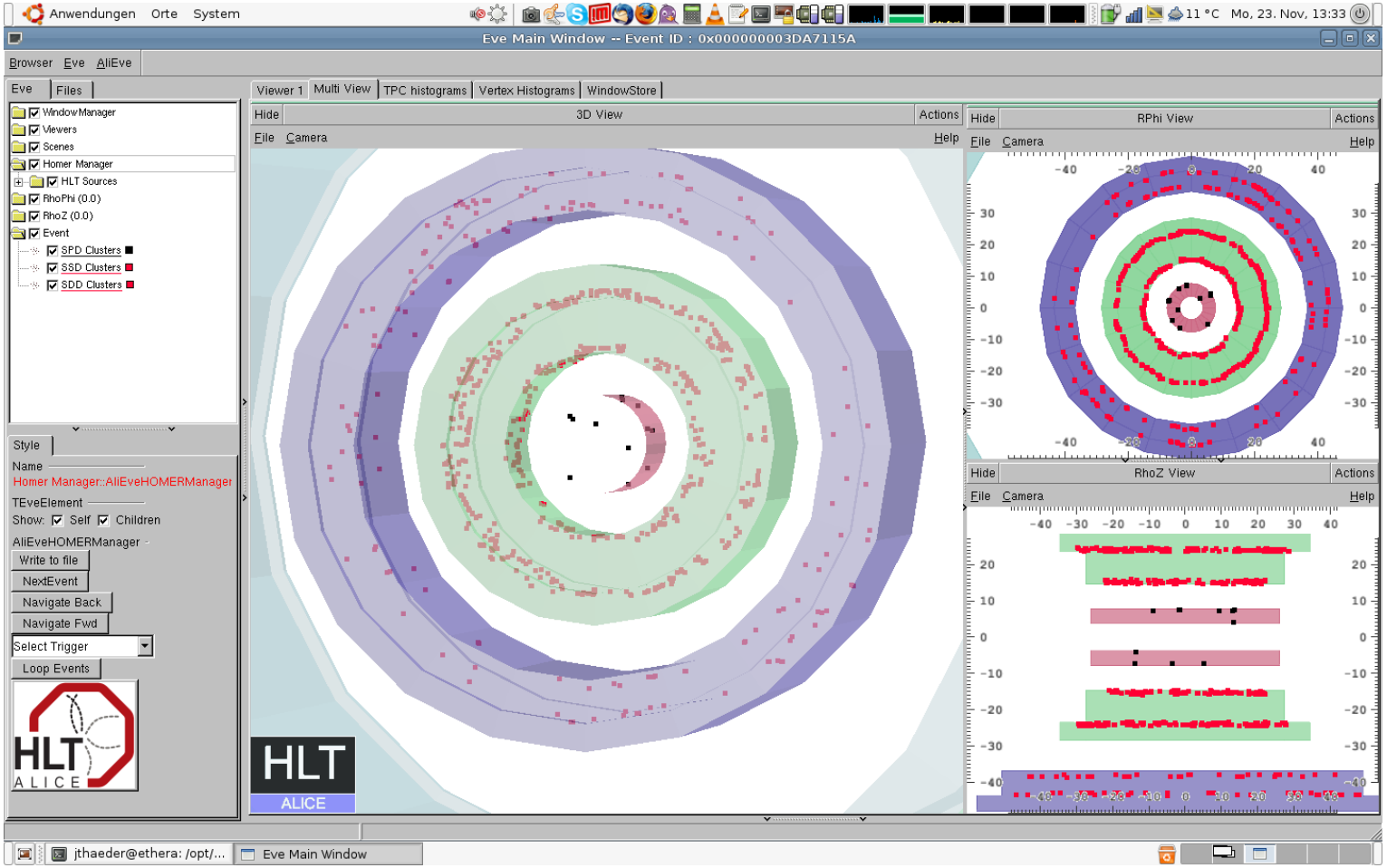
- The design of the experimental areas will be finalized by end '91. The overall lay-out of an experiment should exist by then, if the caverns are to be built ... as well as the need for a Letter of Intent by end ... schedule of the LHC, i.e. even if the start of physics operation, presently foreseen for 1998, should slip somewhat, the extra time will be used to stretch the construction schedule of the machine (and the detec-tors) rather then to delay the start of construction

start of physics operation foreseen for 1998

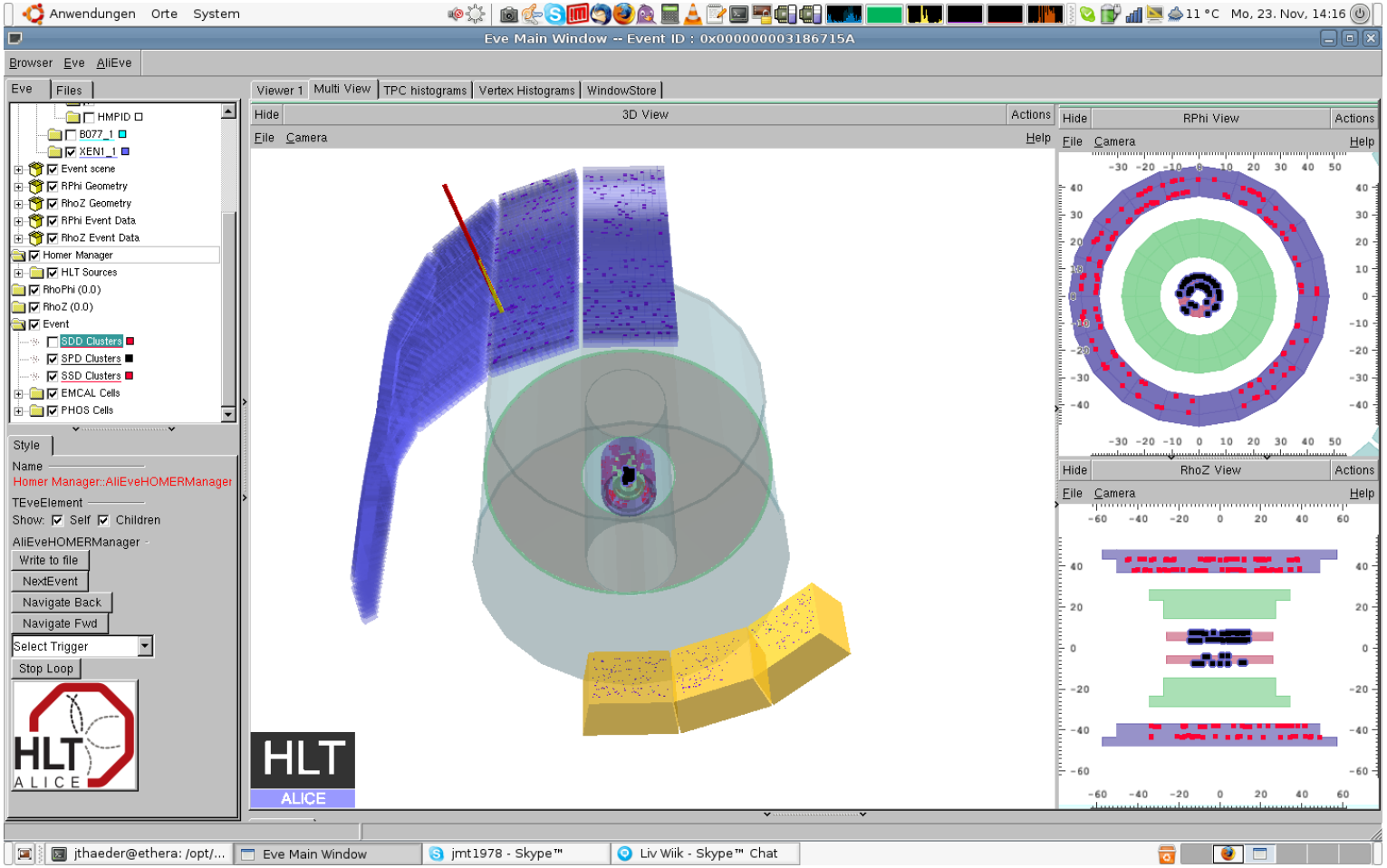
.. should it slip, we stretch the construction schedule ..

LHC startup 2009 and first signals from ALICE

First splashes…



First splashes…



23rd of November 2009…

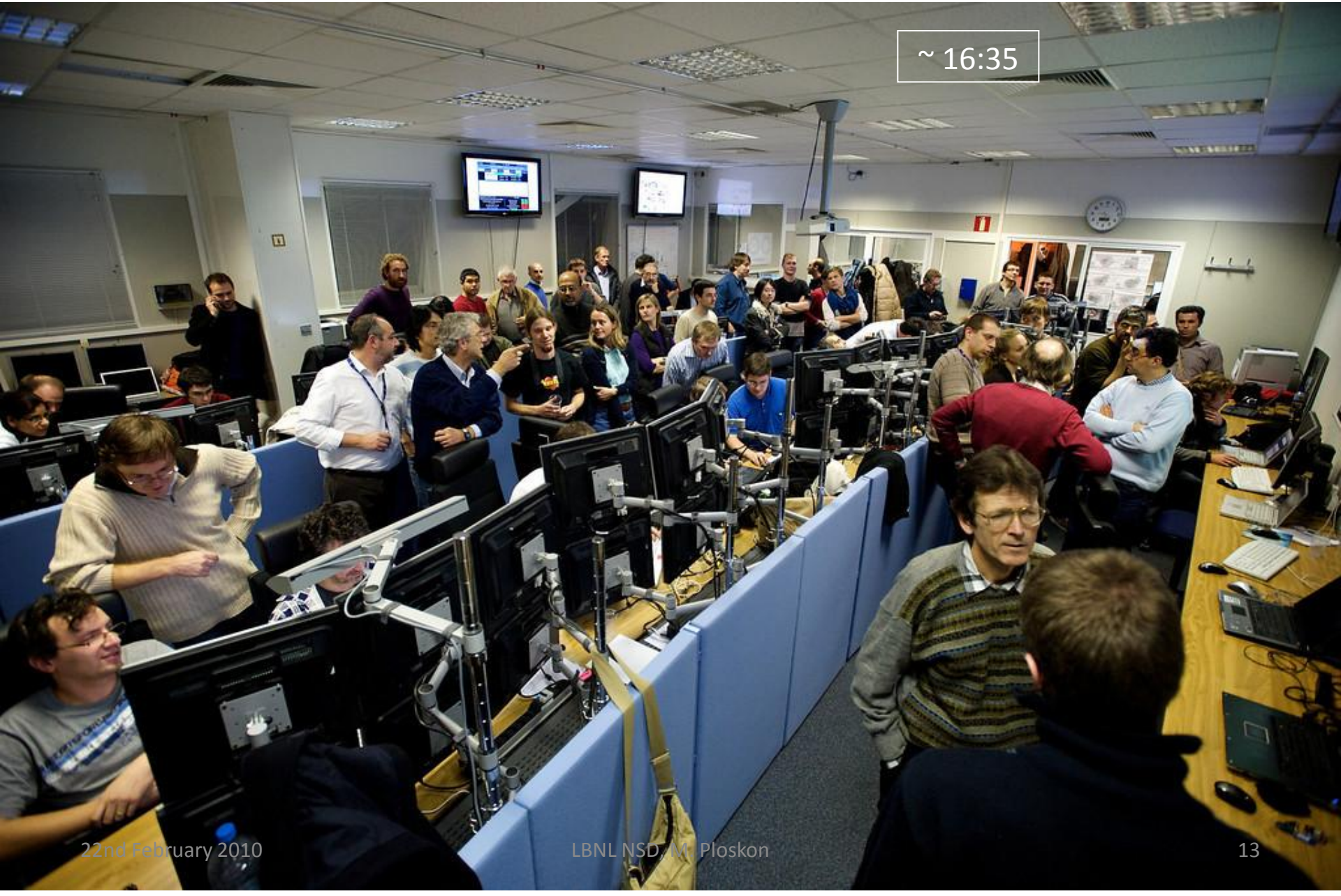
The LHC (and everything else) accelerates ..

.. after concentrated preparations ..

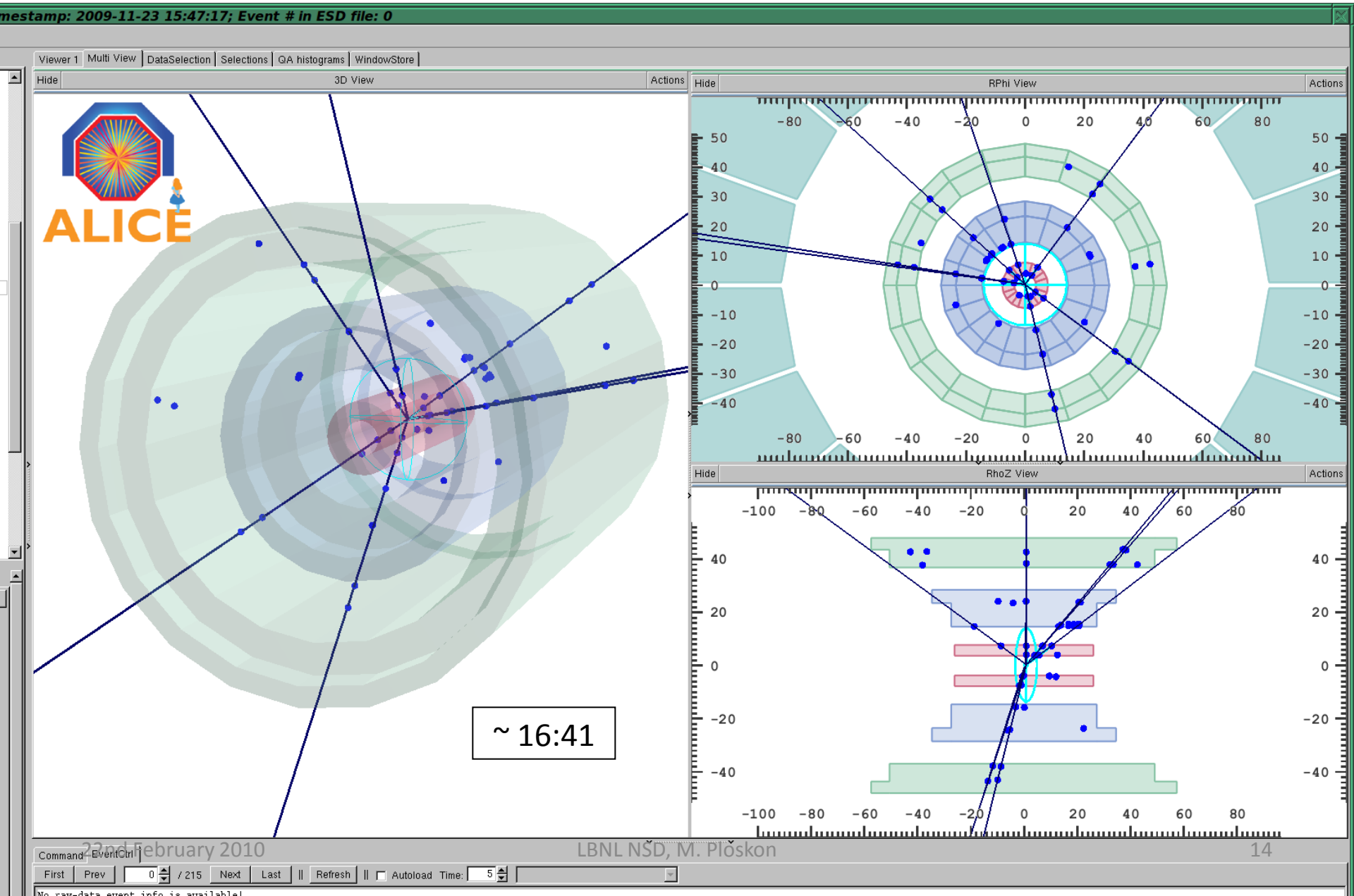
.. and tense anticipation..

Monday, 23rd November, ~15:30
in the ALICE Control Room

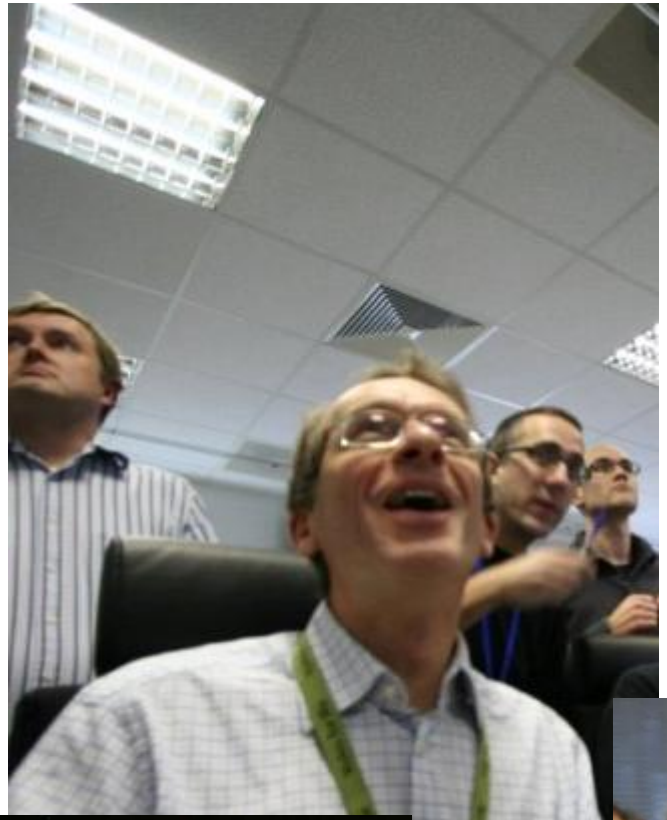
some anxious minutes waiting for collisions..



The first ‘event’…



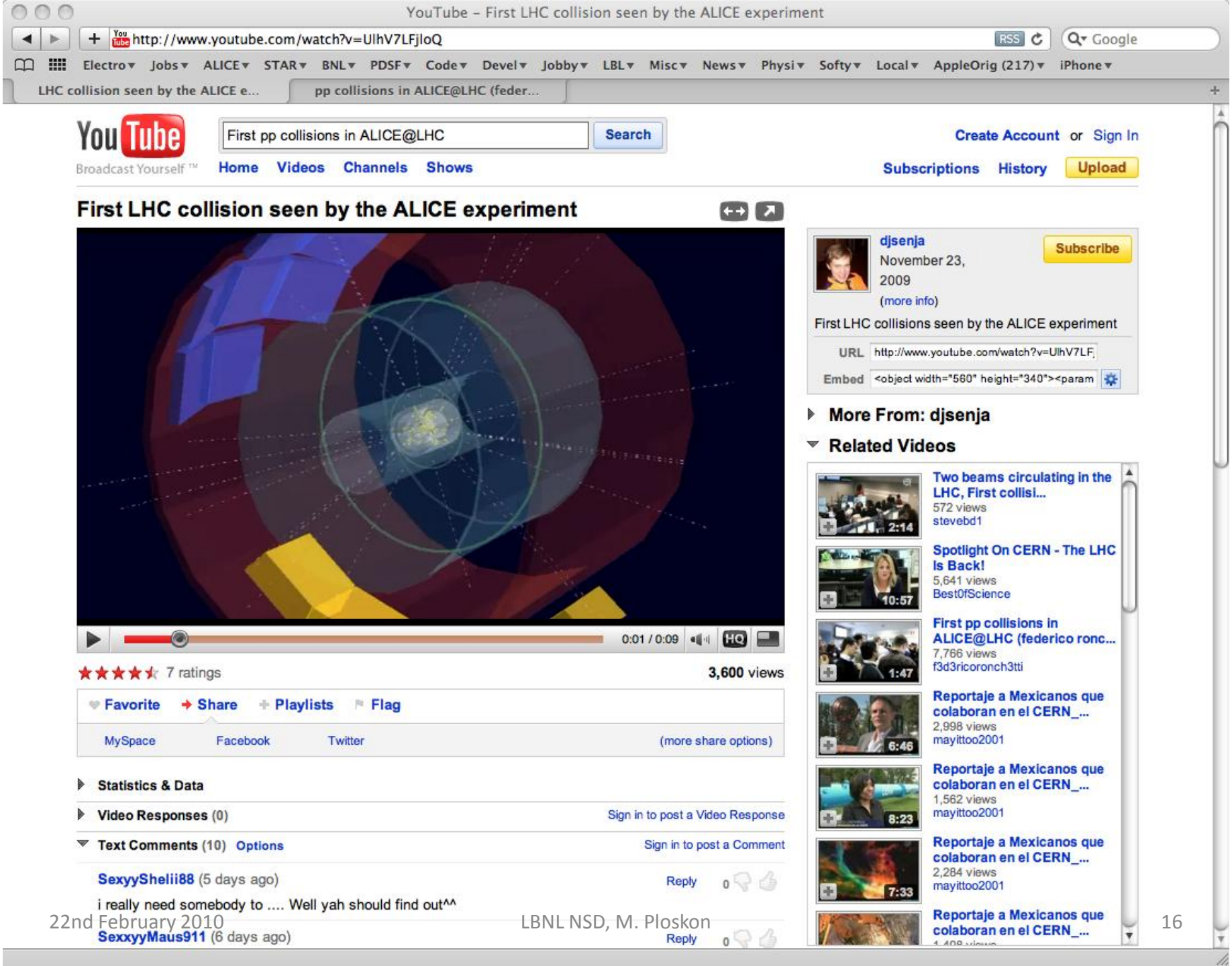
Relief and jubilation..



Collisions in ALICE !!

and some celebration..

~ 16:42


YouTube – First LHC collision seen by the ALICE experiment
http://www.youtube.com/watch?v=UlhV7LFjloQ
Google
Electro Jobs ALICE STAR BNL PDSF Code Devel Jobby LBL Misc News Physi Softy Local AppleOrig (217) iPhone
LHC collision seen by the ALICE e...
pp collisions in ALICE@LHC (feder...
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MySpace Facebook Twitter (more share options)
Statistics & Data
Video Responses (0)
Sign in to post a Video Response
Text Comments (10) Options
Sign in to post a Comment
SexyyShelii88 (5 days ago)
Reply 0
i really need somebody to .... Well yah should find out^^
SexxyyMaus911 (6 days ago)
Reply 0
djsenja
November 23, 2009
(more info)
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8:23
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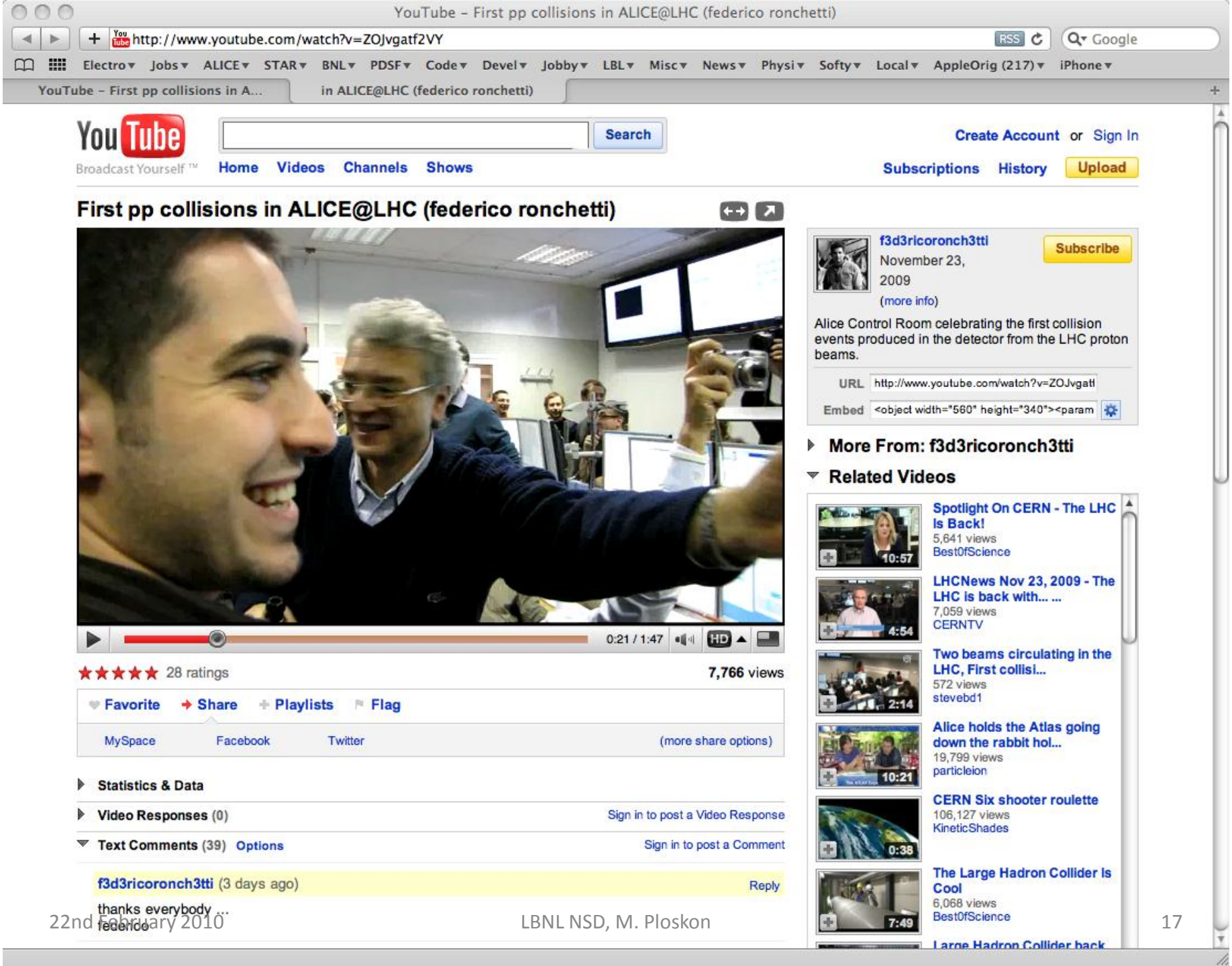
mayittoo2001
7:33
Reportaje a Mexicanos que colaboran en el CERN_...


YouTube – First pp collisions in ALICE@LHC (federico ronchetti)
http://www.youtube.com/watch?v=ZOJvgatf2VY
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First pp collisions in ALICE@LHC (federico ronchetti)
f3d3ricoronch3tti
November 23, 2009
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(more info)
Alice Control Room celebrating the first collision events produced in the detector from the LHC proton beams.
URL http://www.youtube.com/watch?v=ZOJvgatf
Embed <object width="560" height="340"><param
0:21 / 1:47
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7,766 views
Favorite Share Playlists Flag
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Text Comments (39) Options
Sign in to post a Comment
f3d3ricoronch3tti (3 days ago)
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thanks everybody ...
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particleion
CERN Six shooter roulette
106,127 views
KineticShades
The Large Hadron Collider Is Cool
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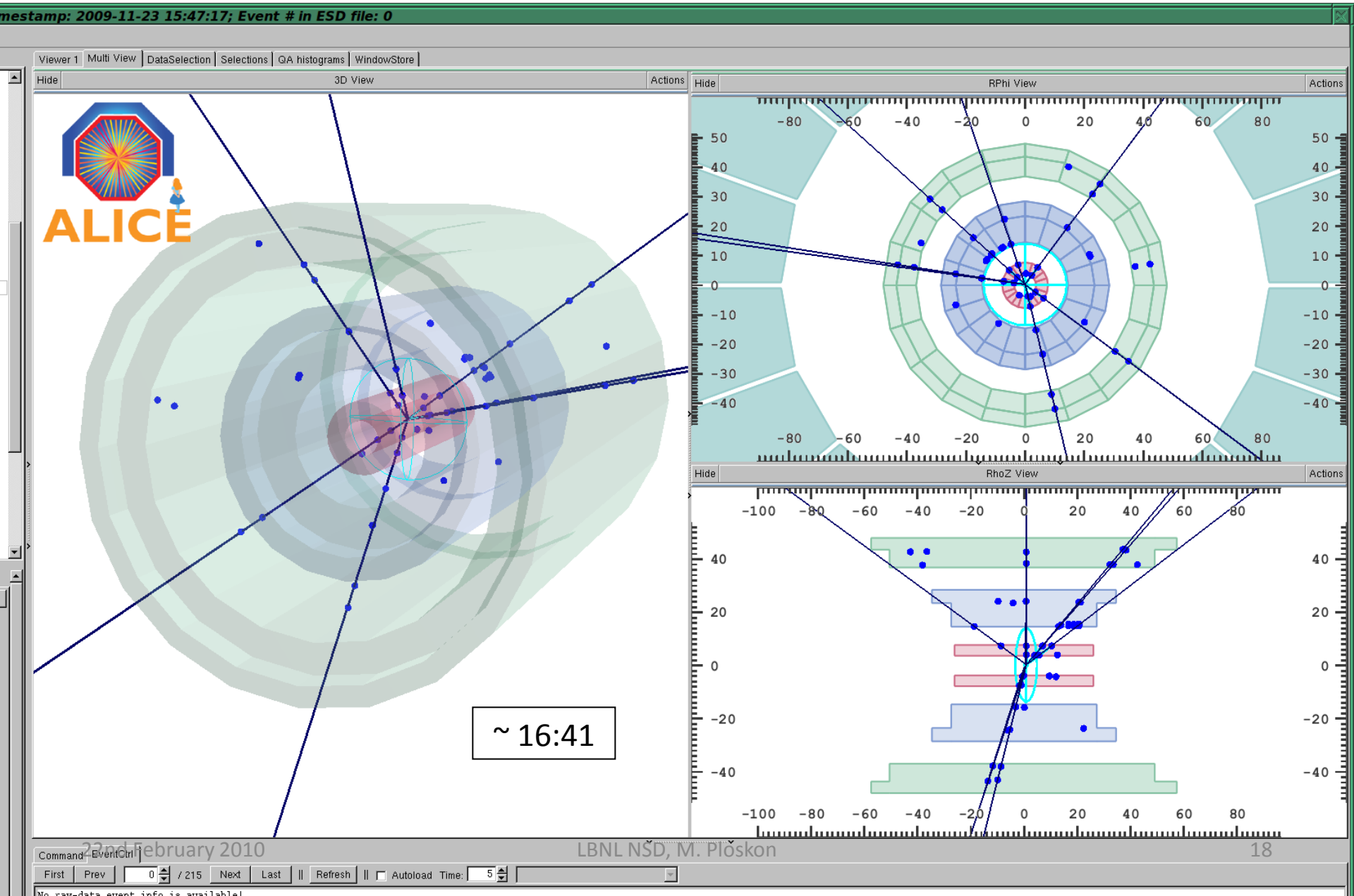
The first and more events to follow…



23rd – 28th of November

EPJ manuscript No.
(will be inserted by the editor)

First proton–proton collisions at the LHC as observed with the ALICE detector: measurement of the charged particle pseudorapidity density at $\sqrt{s} = 900$ GeV

ALICE collaboration

K. Aamodt[78], N. Abel[43], U. Abeysekara[30], A. Abrahantes Quintana[42], A. Acero[63], D. Adamová[86], M.M. Aggarwal[25], G. Aglieri Rinella[40], A.G. Agocs[18], S. Aguilar Salazar[66], Z. Ahammed[55], A. Ahmad[2], N. Ahmad[2], S.U. Ahn[50], R. Akimoto[100], A. Akindinov[68], D. Aleksandrov[70], B. Alessandro[102], R. Alfaro Molina[66], A. Alici[13], E. Almaráz Aviña[66], J. Alme[8], T. Alt[43], V. Altini[6], S. Altinpinar[32], C. Andrei[17], A. Andronic[32], G. Anelli[40], V. Angelov[43], C. Anson[27], T. Antičić[113], F. Antinori[40], S. Antinori[13], K. Antipin[37], D. Antończyk[37], P. Antonioli[14], A. Anzo[66], L. Aphecetche[75], H. Appelshäuser[37], S. Arcelli[13], R. Arceo[66], A. Arend[37], N. Armesto[92], R. Arnaldi[102], T. Aronsson[74], I.C. Arsene[78], A. Asryan[98], A. Augustinus[40], R. Averbeck[32], T.C. Awes[76], J. Äystö[49], M.D. Azmi[2], S. Bablok[8], M. Bach[36], A. Badalà[24], Y.W. Baek[50], S. Bagnasco[102], R. Bailhache[32], R. Bala[101], A. Baldisseri[89], A. Baldit[26], J. Bán[58], R. Barbera[23], G.G. Barnaföldi[18], L. Barnby[12], V. Barret[26], J. Bartke[29], F. Barile[5], M. Basile[13], V. Basmanov[94], N. Bastid[26], B. Bathen[72], G. Batigne[75], B. Batyunya[35], C. Baumann[72], I.G. Bearden[28], B. Becker[20],

23rd – 28th of November

EPJ manuscript No.
(will be inserted by the editor)

arXiv:0911.5430v2 [hep-ex]
Submitted on 28th November
Accepted on 1st of December

First proton… HC as observed with the ALI… of the charged particle pseudorap… 900 GeV

ALICE collabora…

K. Aamodt[78], N. Abel[4… eysekara[30], A. Abrahantes Quintana[42], A. Acero[63], D. Adamová[86], M.M. Aggarwal[25], G. Aglieri Rinella[40], A.G… Agocs[18], S. Aguilar Salazar[66], Z. Ahammed[55], A. Ahmad[2], N. Ahmad[2], S.U. Ahn[50], R. Akimoto[100], A. Akindinov[68], D. Aleksandrov[70], B. Alessandro[102], R. Alfaro Molina[66], A. Alici[13], E. Almaráz Aviña[66], J. Alme[8], T. Alt[43], V. Altini[6], S. Altinpinar[32], C. Andrei[17], A. Andronic[32], G. Anelli[40], V. Angelov[43], C. Anson[27], T. Antičić[113], F. Antinori[40], S. Antinori[13], K. Antipin[37], D. Antończyk[37], P. Antonioli[14], A. Anzo[66], L. Aphecetche[75], H. Appelshäuser[37], S. Arcelli[13], R. Arceo[66], A. Arend[37], N. Armesto[92], R. Arnaldi[102], T. Aronsson[74], I.C. Arsene[78], A. Asryan[98], A. Augustinus[40], R. Averbeck[32], T.C. Awes[76], J. Äystö[49], M.D. Azmi[2], S. Bablok[8], M. Bach[36], A. Badalà[24], Y.W. Baek[50], S. Bagnasco[102], R. Bailhache[32], R. Bala[101], A. Baldisseri[89], A. Baldit[26], J. Bán[58], R. Barbera[23], G.G. Barnaföldi[18], L. Barnby[12], V. Barret[26], J. Bartke[29], F. Barile[5], M. Basile[13], V. Basmanov[94], N. Bastid[26], B. Bathen[72], G. Batigne[75], B. Batyunya[35], C. Baumann[72], I.G. Bearden[28], B. Becker[20],

28 Nov 2009

1 Introduction

The very first proton–proton collisions at Point 2 of the CERN Large Hadron Collider (LHC) [1] occurred in the afternoon of 23rd November 2009, at a centre-of-mass energy $\sqrt{s} = 900\,\mathrm{GeV}$, during the commissioning of the accelerator. This publication, based on 284 events recorded in the ALICE detector [2] on that day, describes a determination of the pseudorapidity density of charged primary

[1] Here, primary particles are defined as prompt particles produced in the collision and all decay products, except products from weak decays of strange particles such as K^0_s and Λ.

Shortly after circulating beams were established, the ALICE data aquisition system [11] started collecting events with a trigger based on the Silicon Pixel Detector (SPD), requiring two or more hits in the SPD in coincidence with the passage of the two colliding bunches as inferred from beam pickup detectors. As a precaution, only a small subset of the detector subsystems, including the silicon tracking detectors and the scintillator trigger counters, was turned on, in order to assess the beam conditions provided by the LHC.

The trigger rate was measured just before collisions with the same trigger conditions. Without beams we measured a rate of 3×10^{-4} Hz (in coincidence with one bunch crossing interval per orbit). In coincidence with the passage of the bunch of one circulating beam the rate was 0.006 Hz. As soon as the second beam was injected in the accelerator, the event rate increased significantly, to 0.11 Hz. The first event which was analyzed and displayed in the counting room by the offline reconstruction software AliRoot [12] running in online mode is shown in Fig. 1. This marked symbolically the keenly anticipated start of the physics exploitation of the ALICE experiment[3]. The online reconstruction software implemented in the High-Level Trigger (HLT) computer farm [13] also analyzed the events in real time and calculated the vertex position of the collected events, shown in Fig. 2. The distributions

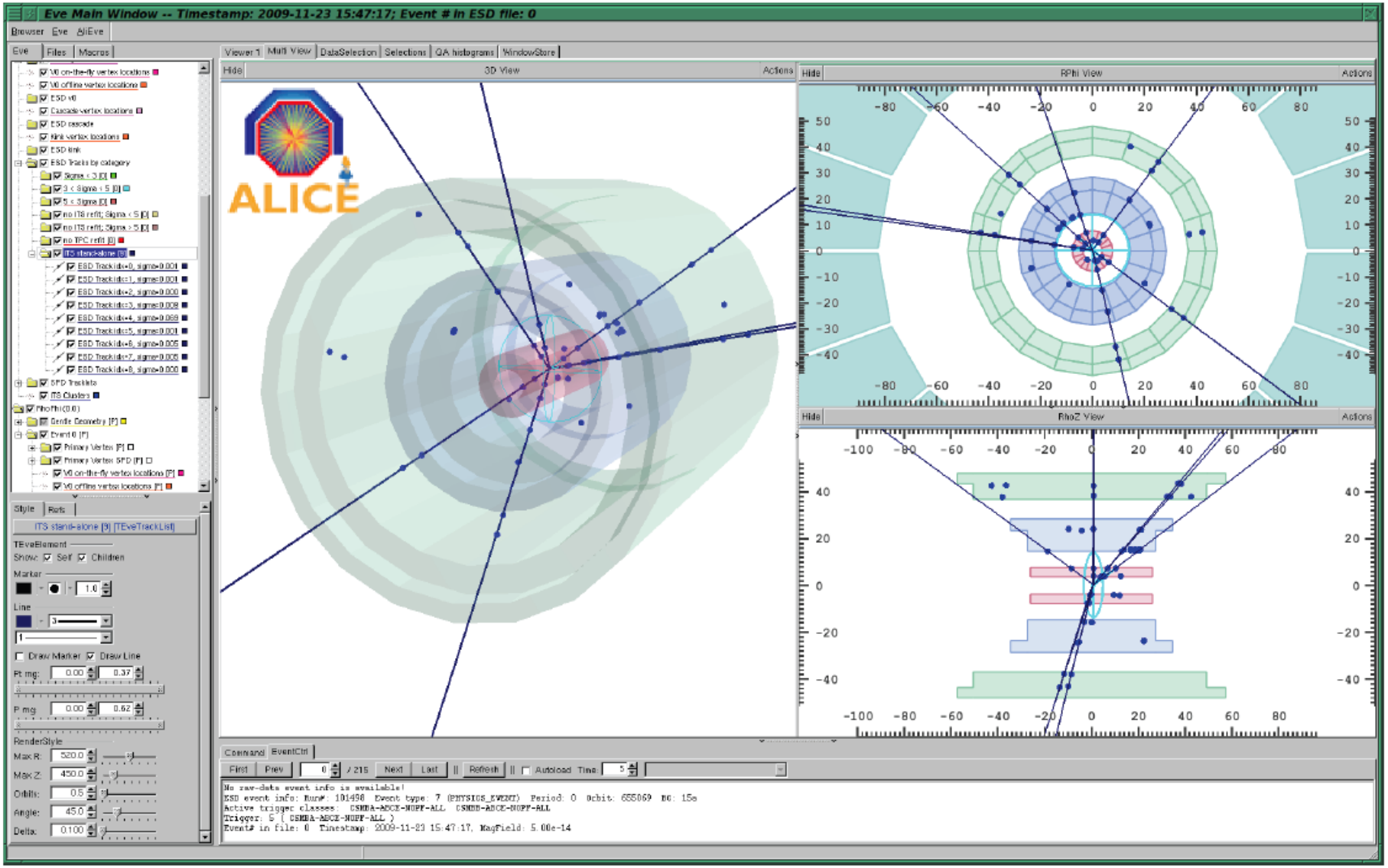


Fig. 1. The first pp collision candidate shown by the event display in the ALICE counting room (3D view, r-ϕ and r-z projections), the dimensions are shown in cm. The dots correspond to hits in the silicon vertex detectors (SPD, SDD and SSD), the lines correspond to tracks reconstructed using loose quality cuts. The ellipse drawn in the middle of the detector surrounds the reconstructed event vertex.

Collision vertex as seen online by High Level Trigger

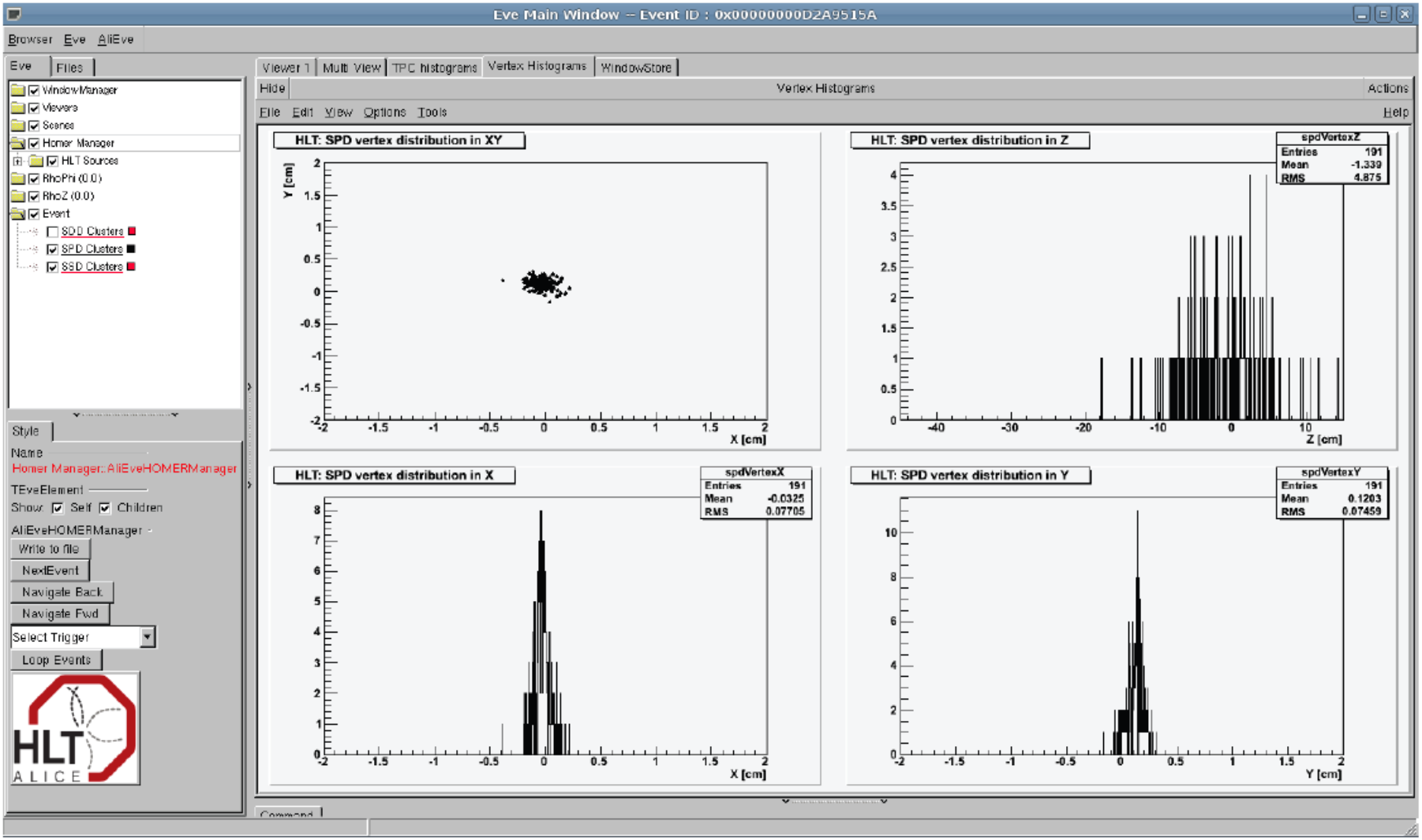
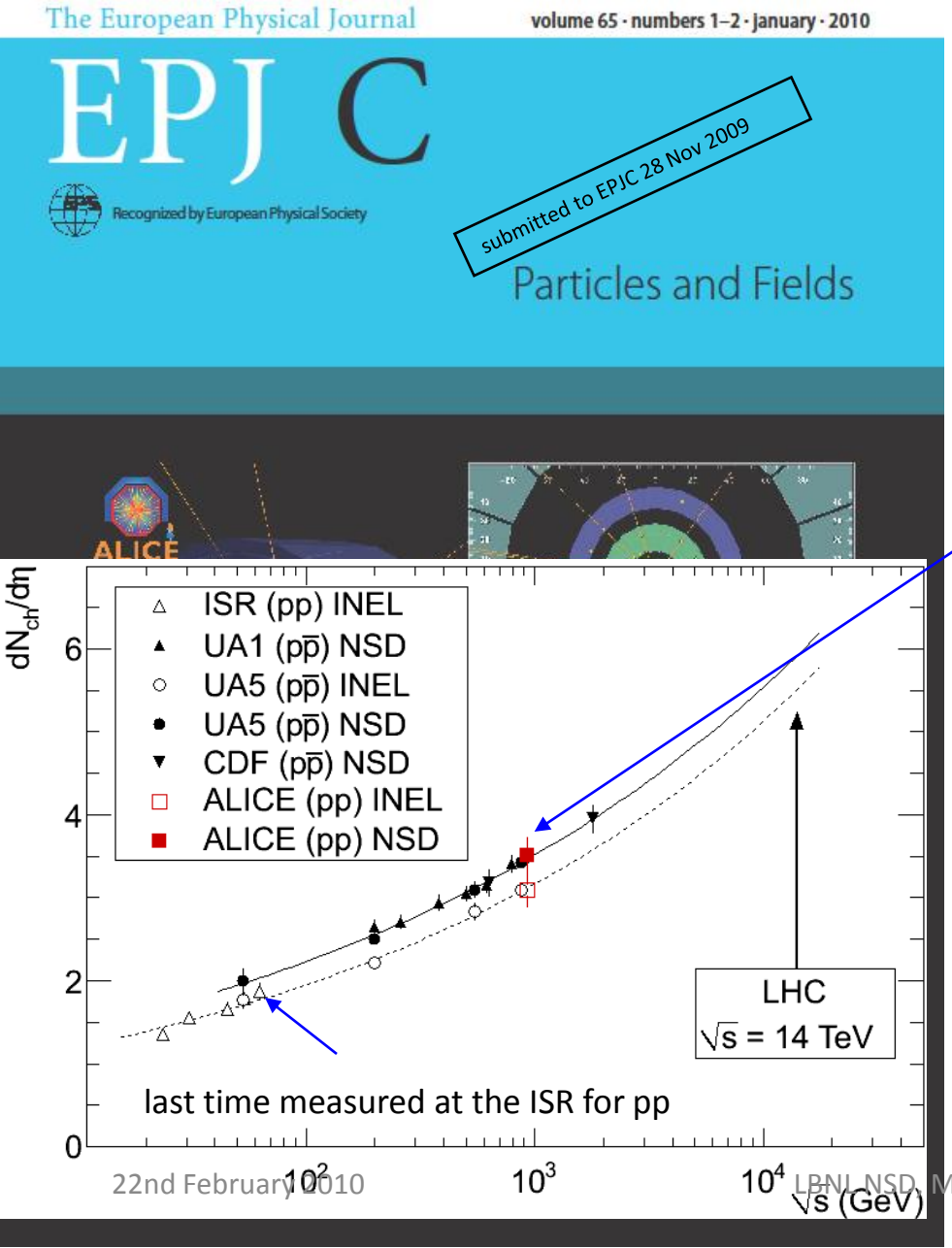


Fig. 2. Online display of the vertex positions reconstructed by the High-Level Trigger (HLT). The figure shows, counter-clockwise from top left, the position in the transverse plane for all events with a reconstructed vertex, the projections along the transverse coordinates x and y, and the distribution along the beam line (z-axis).

ALICE has started!



Phase 1: rediscovering the standard model

(QCD in the case of ALICE)

The average number of charged particles created perpendicular to the beam in pp collisions at 900 GeV is:

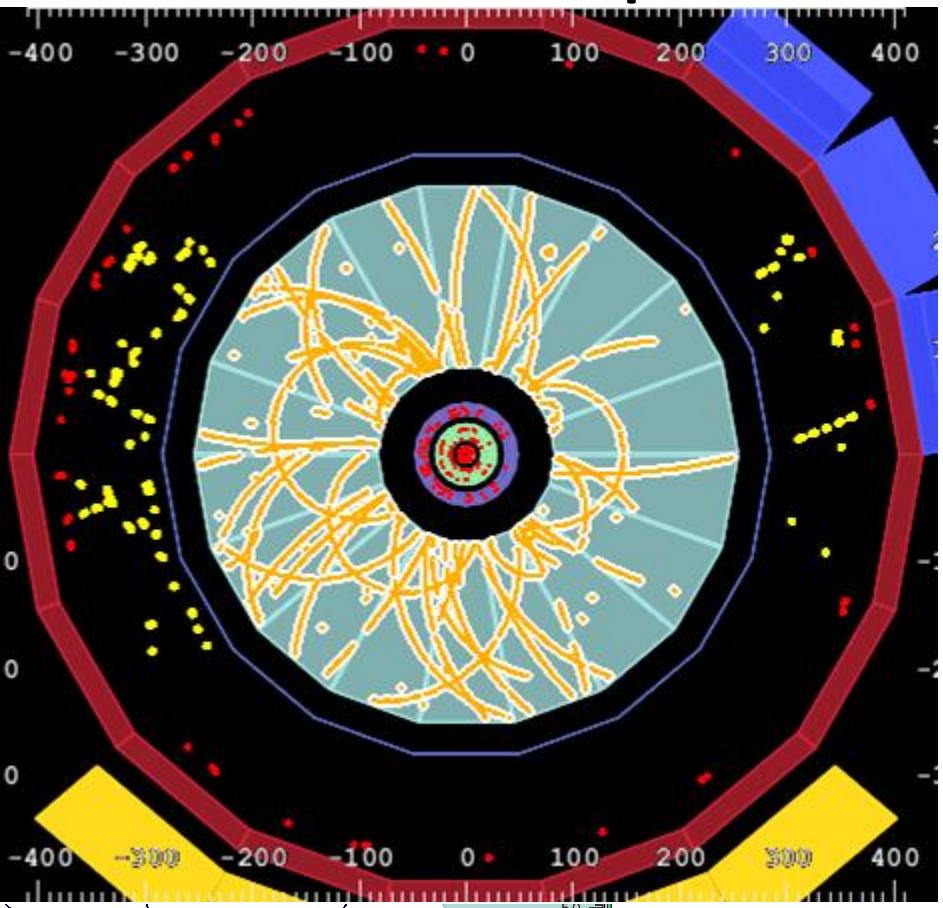
$dN/d\eta = 3.10 \pm 0.13\ (stat) \pm 0.22\ (syst) \approx \pi$

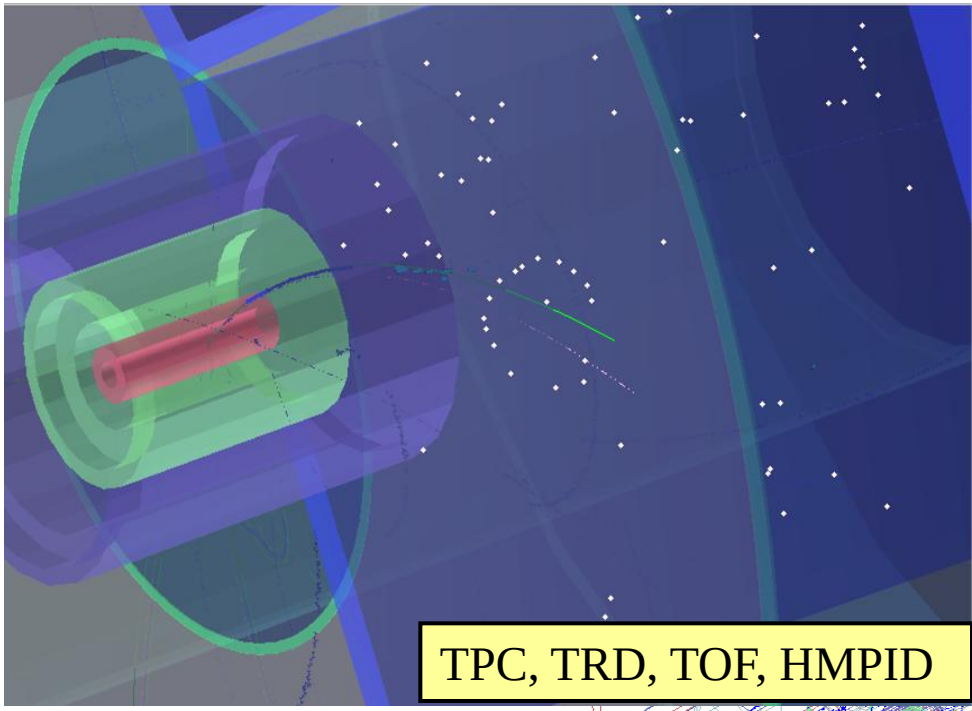
National Geographic News (4 Dec.)

'….a machine called ALICE.... found that **a** (!) proton-proton collision recorded on November 23

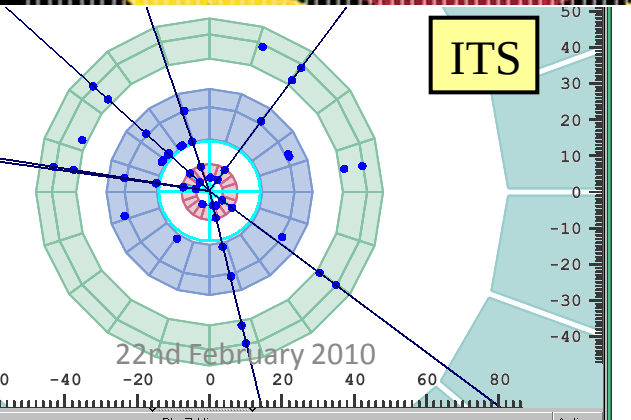
This is the first (and easiest) of many numbers we need to (re)measure to get confidence in our detectors, tune the simulations, study background, ...
Phase 2 is still a long way to go..

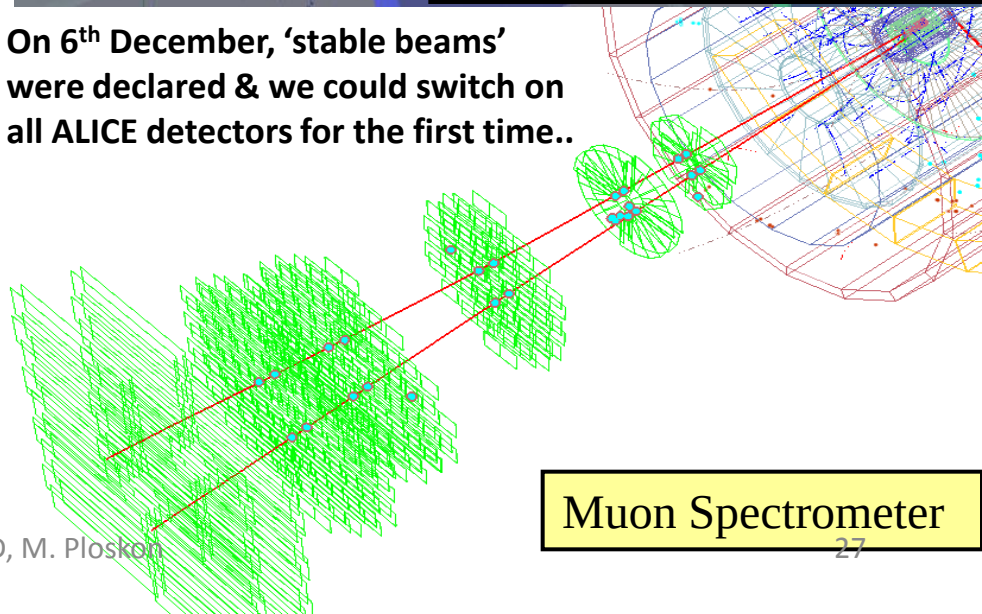
The Drop has become a Trickle ..



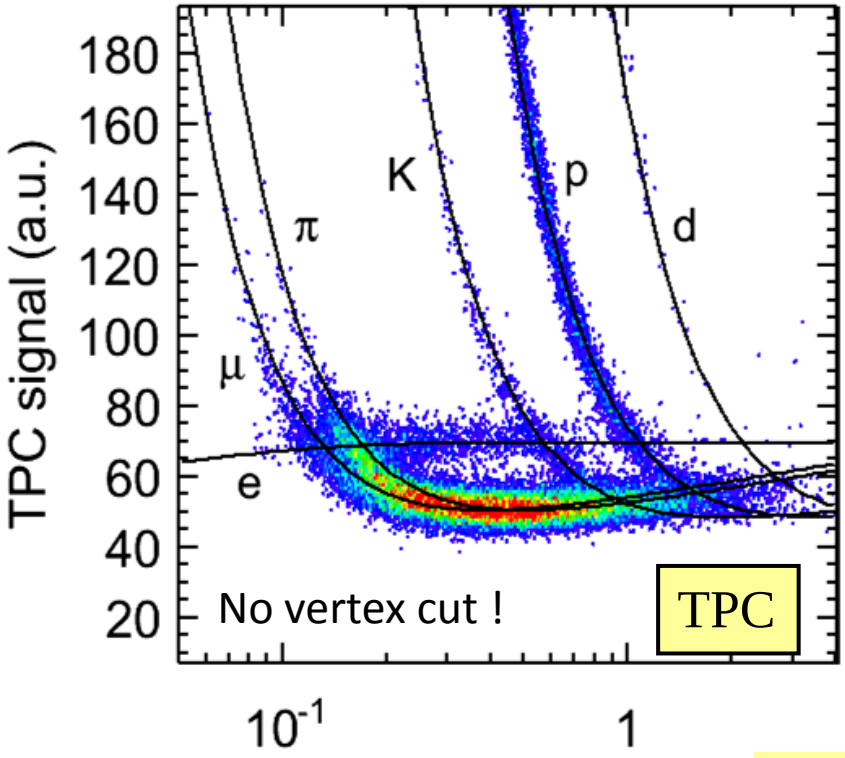


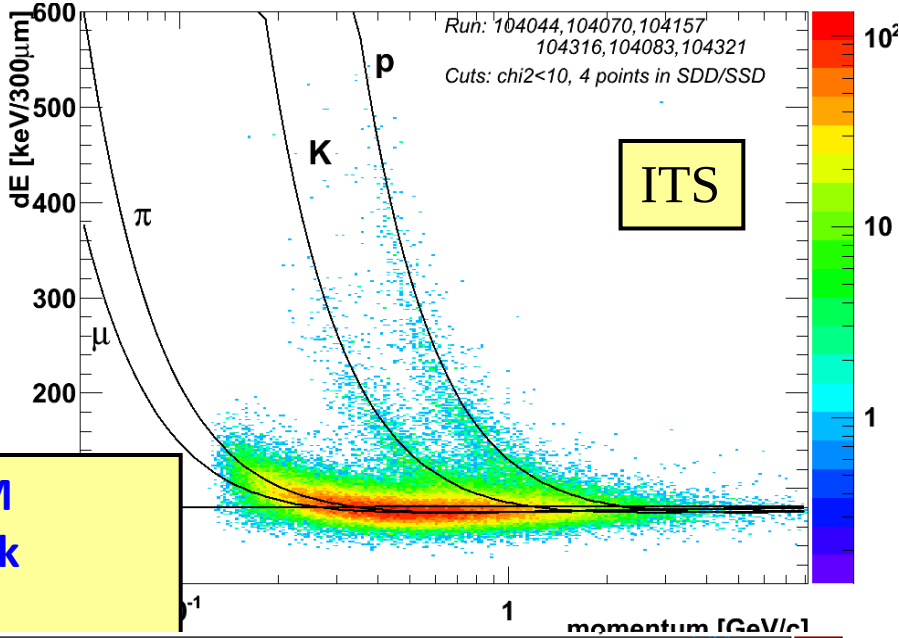
On 6th December, 'stable beams' were declared & we could switch on all ALICE detectors for the first time..





.. and the Trickle is becoming a Flood..





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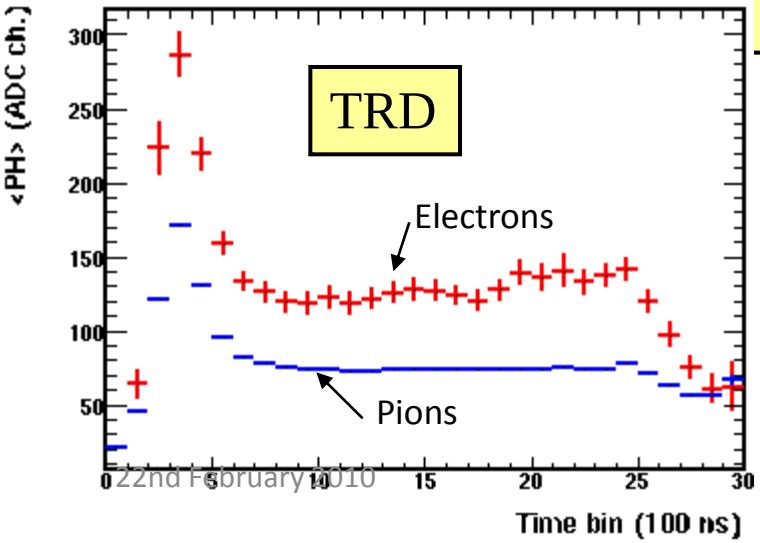
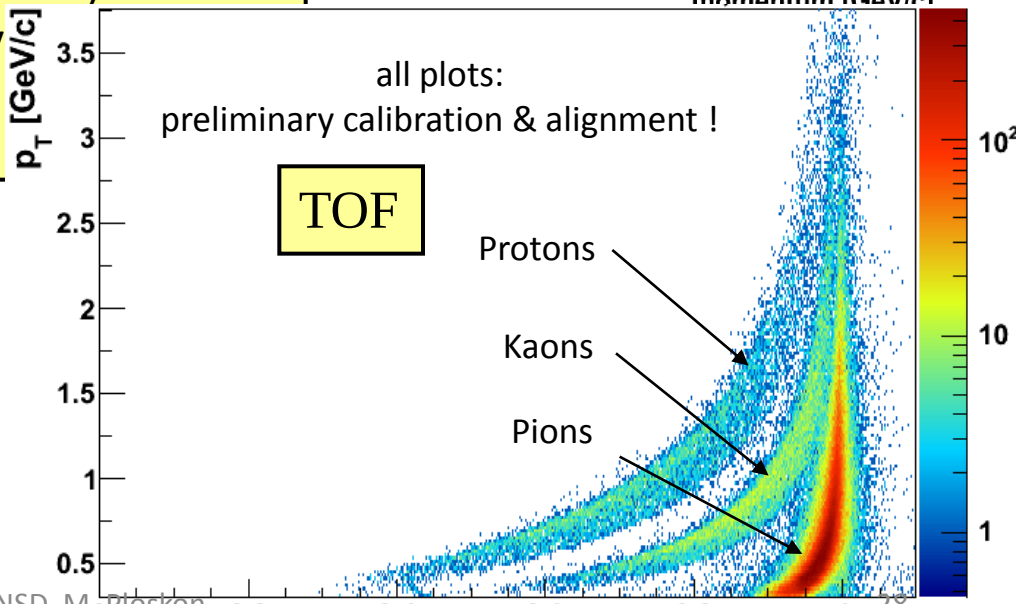
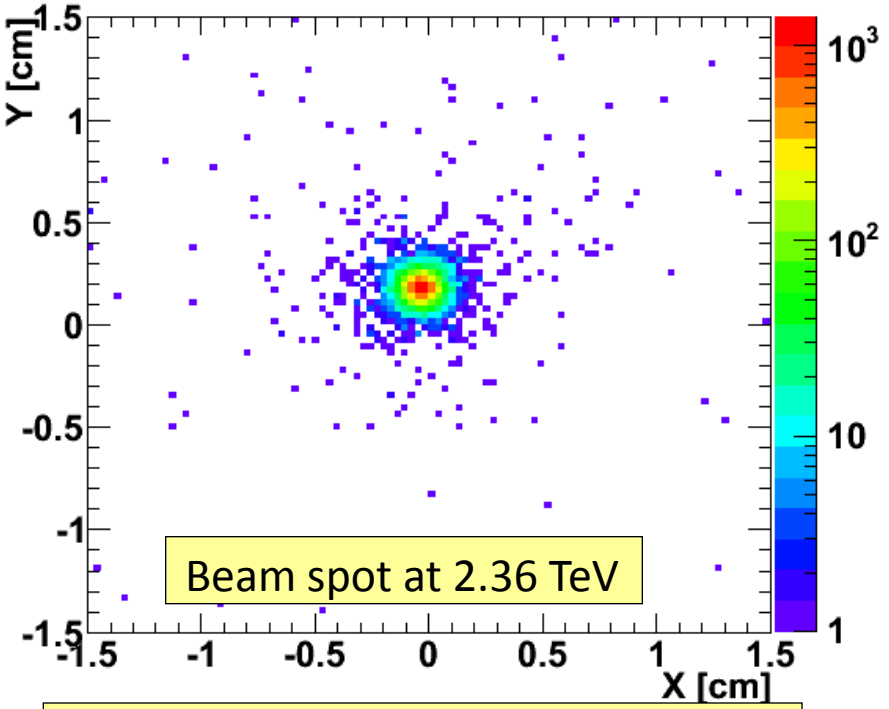
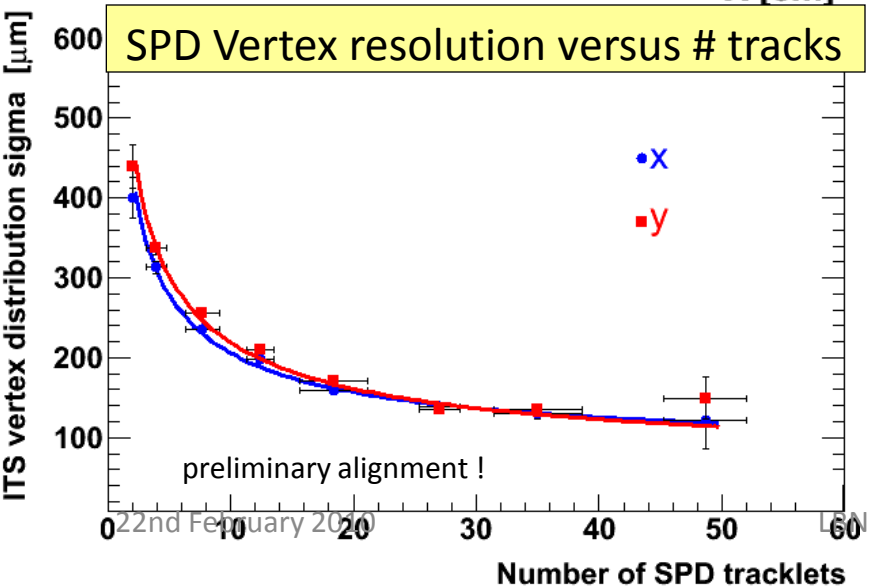
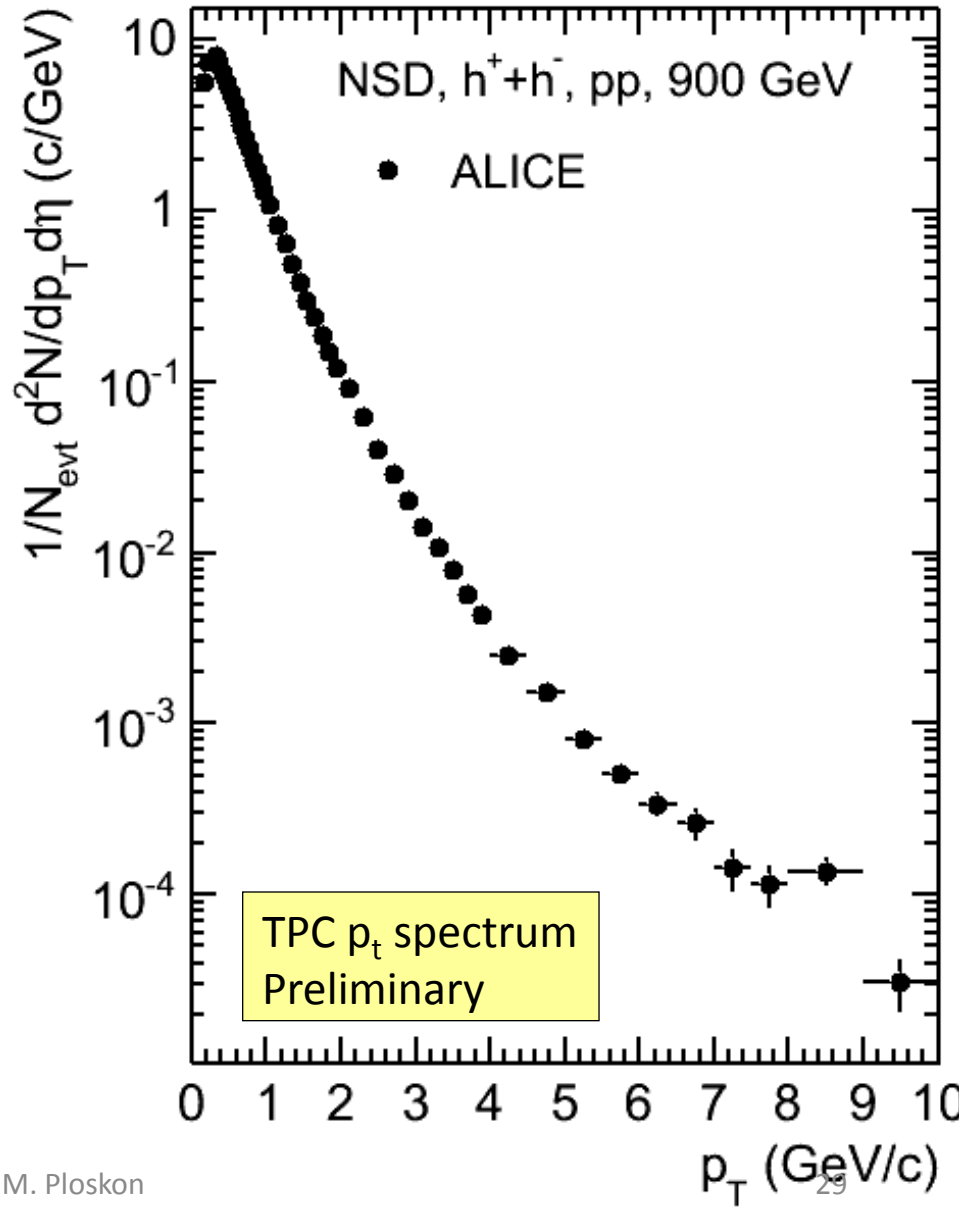




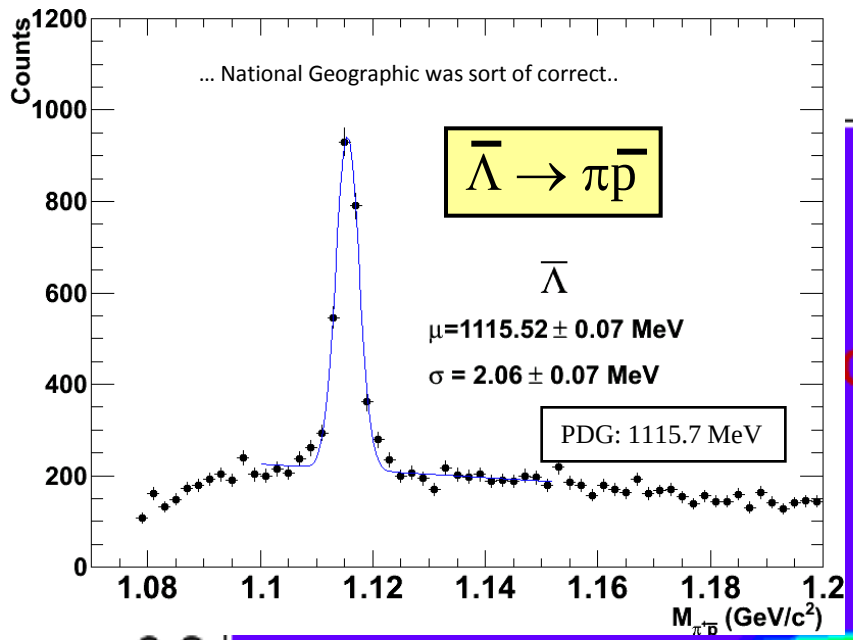
Tracking works beautifully

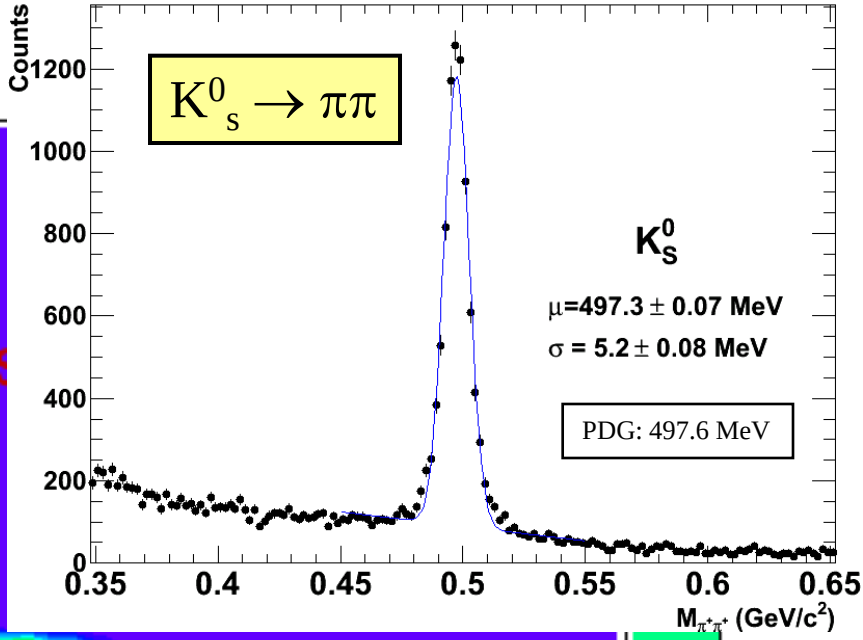


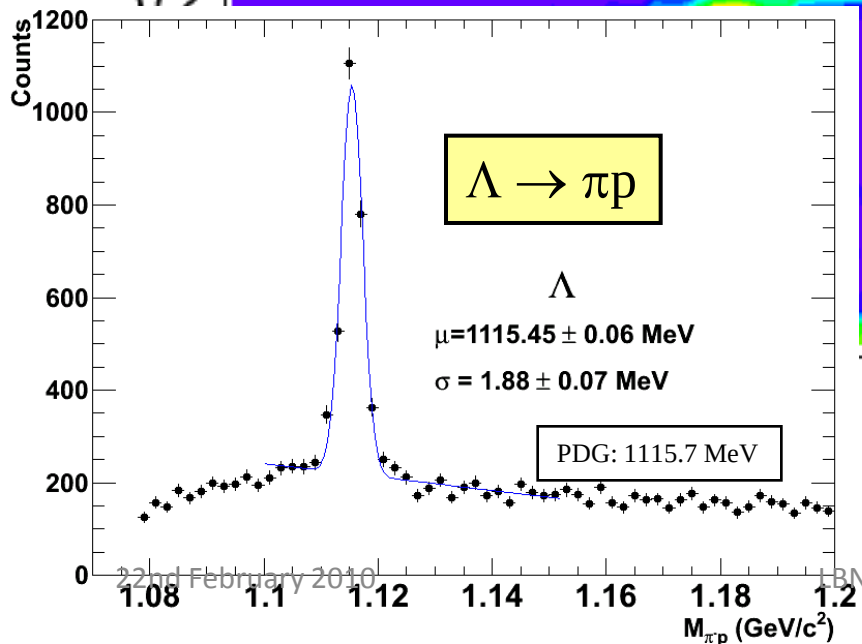


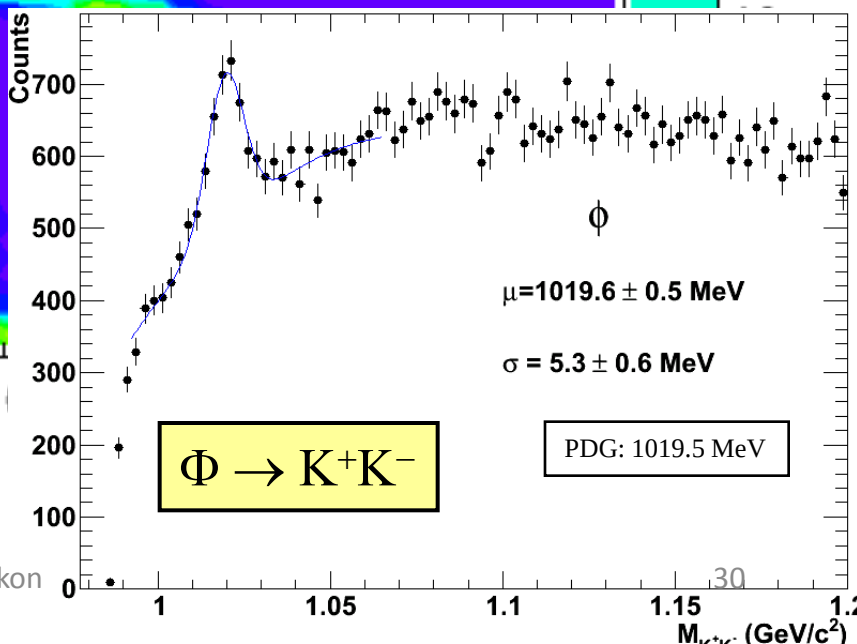


The Particle Zoo Revisited:

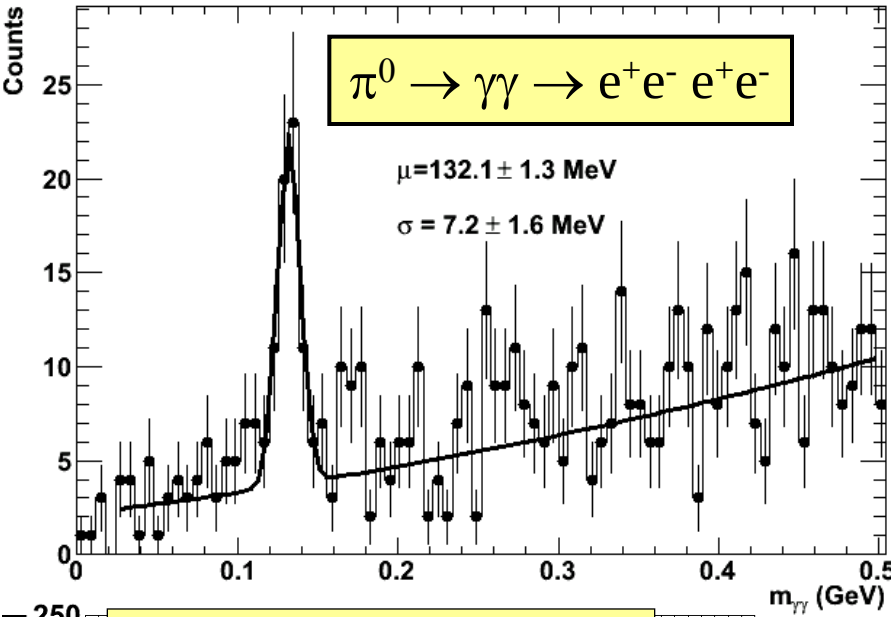


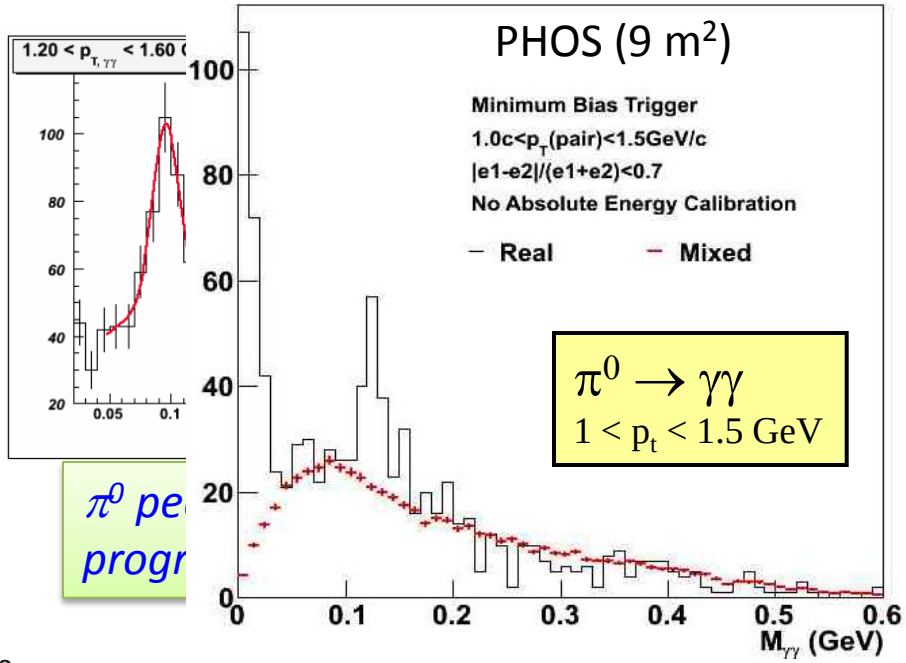


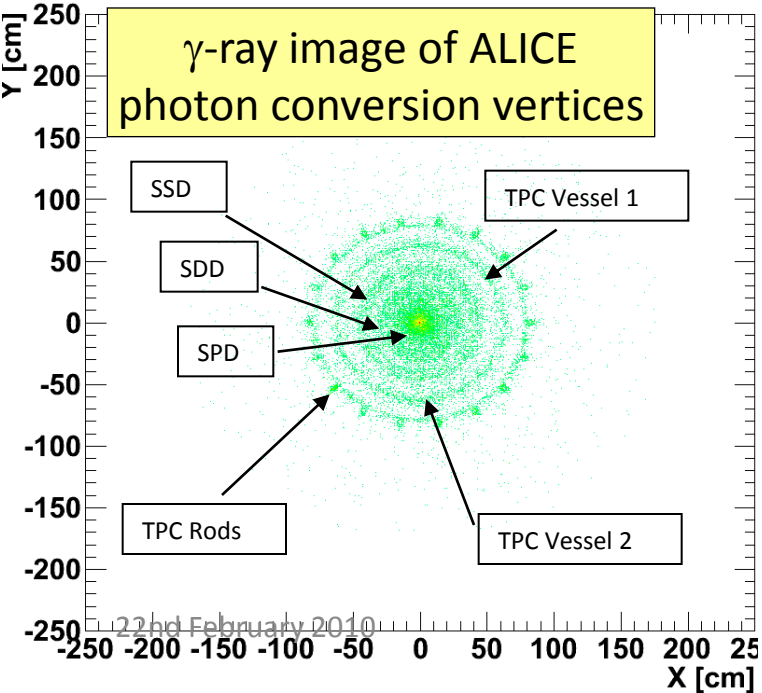


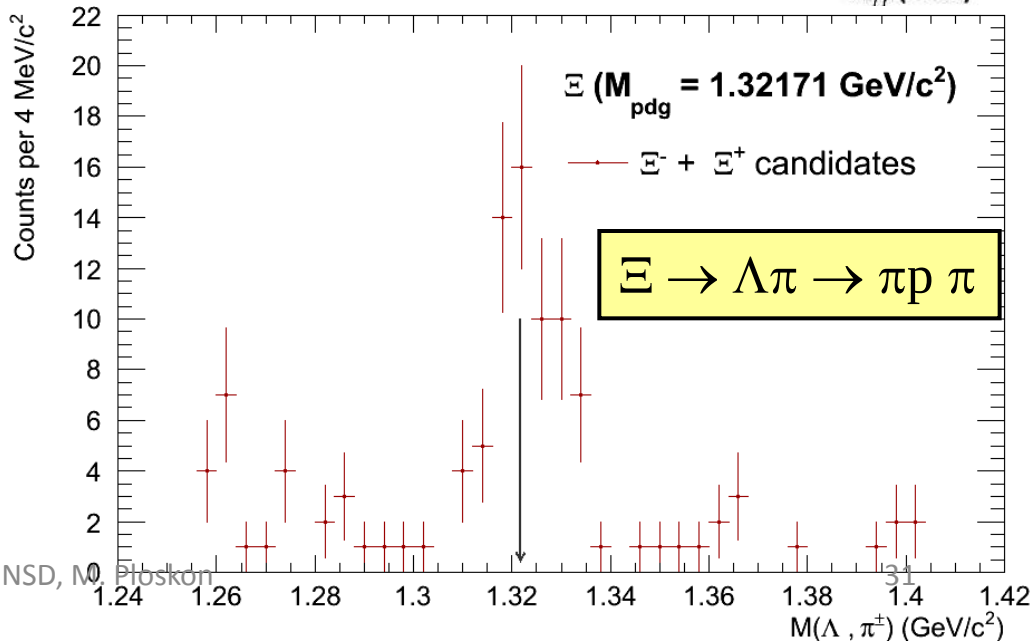


More Particles..

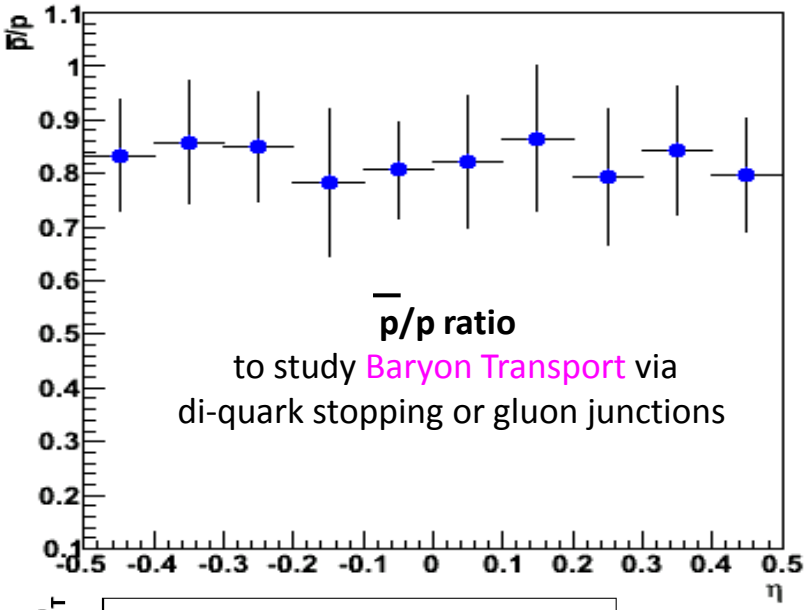




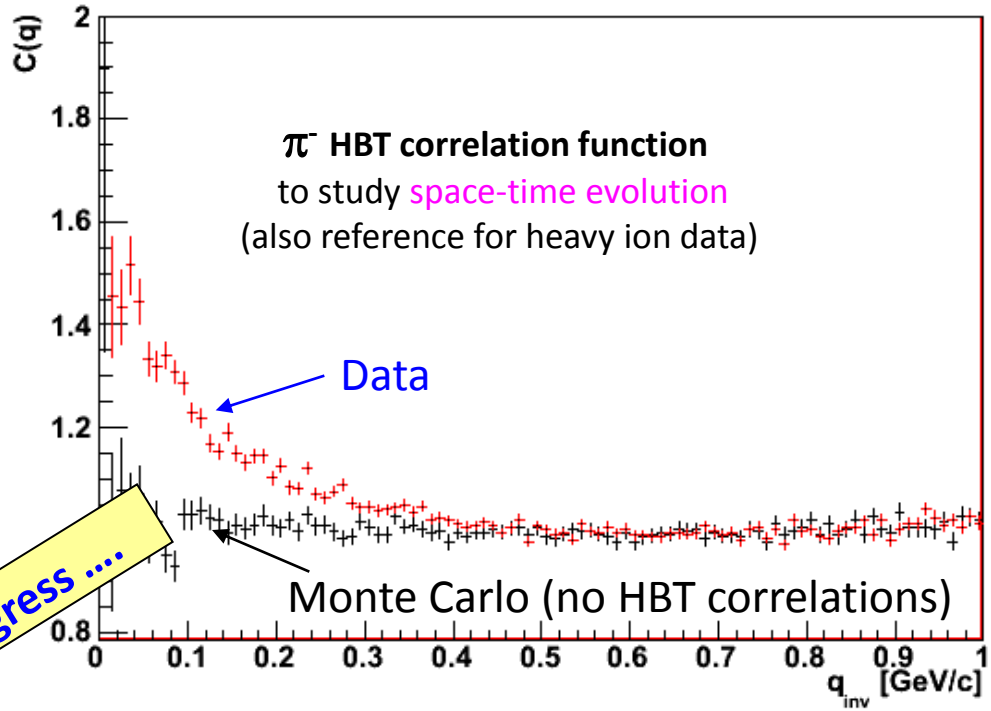




A taste of things to come..

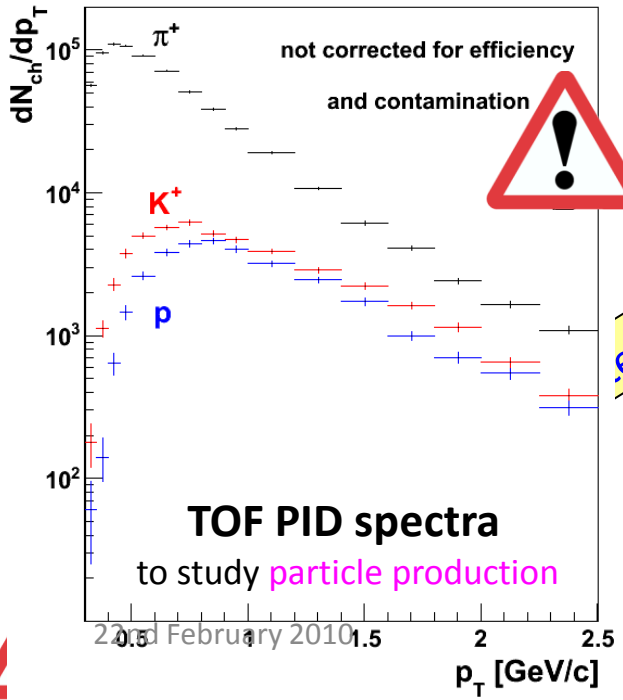


$\bar{p}$/p ratio
to study Baryon Transport via
di-quark stopping or gluon junctions



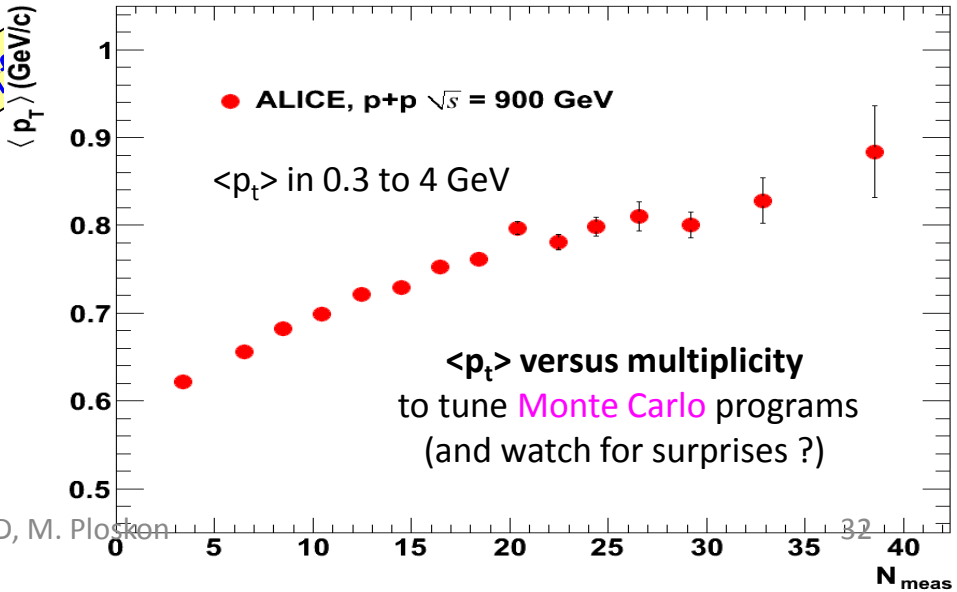
π^- HBT correlation function
to study space-time evolution
(also reference for heavy ion data)

Work in progress ....



TOF PID spectra
to study particle production

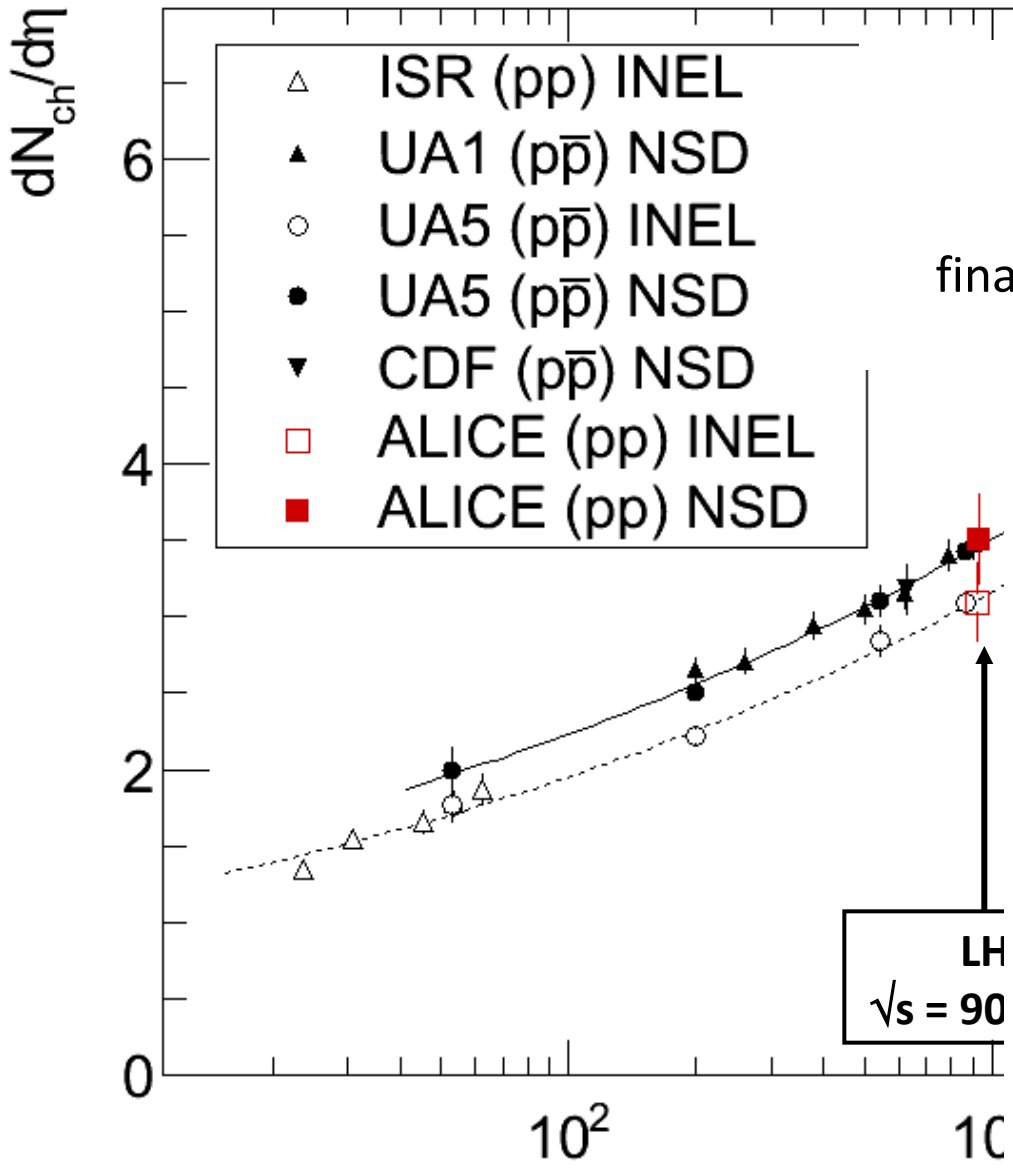
e correction for ef



$\langle p_t \rangle$ in 0.3 to 4 GeV

$\langle p_t \rangle$ versus multiplicity
to tune Monte Carlo programs
(and watch for surprises ?)

Analysis in progress…



Work in progress..

dN/dη at 2.36 TeV

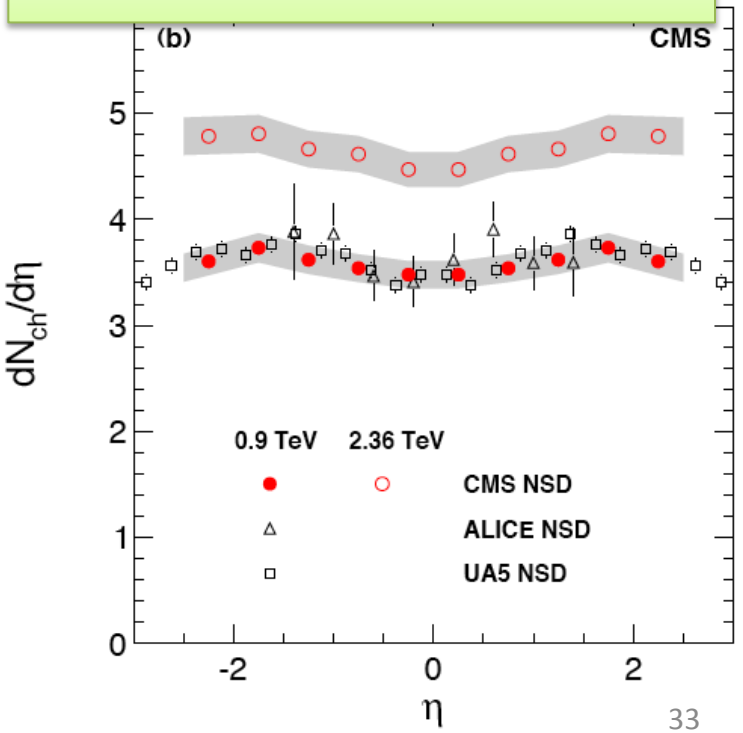
statistical error negligible

final systematic error under evaluation

(still 7% for the time being)

CMS: arXiv:1002.0621v2 [hep-ex]

~3rd Feb 2010

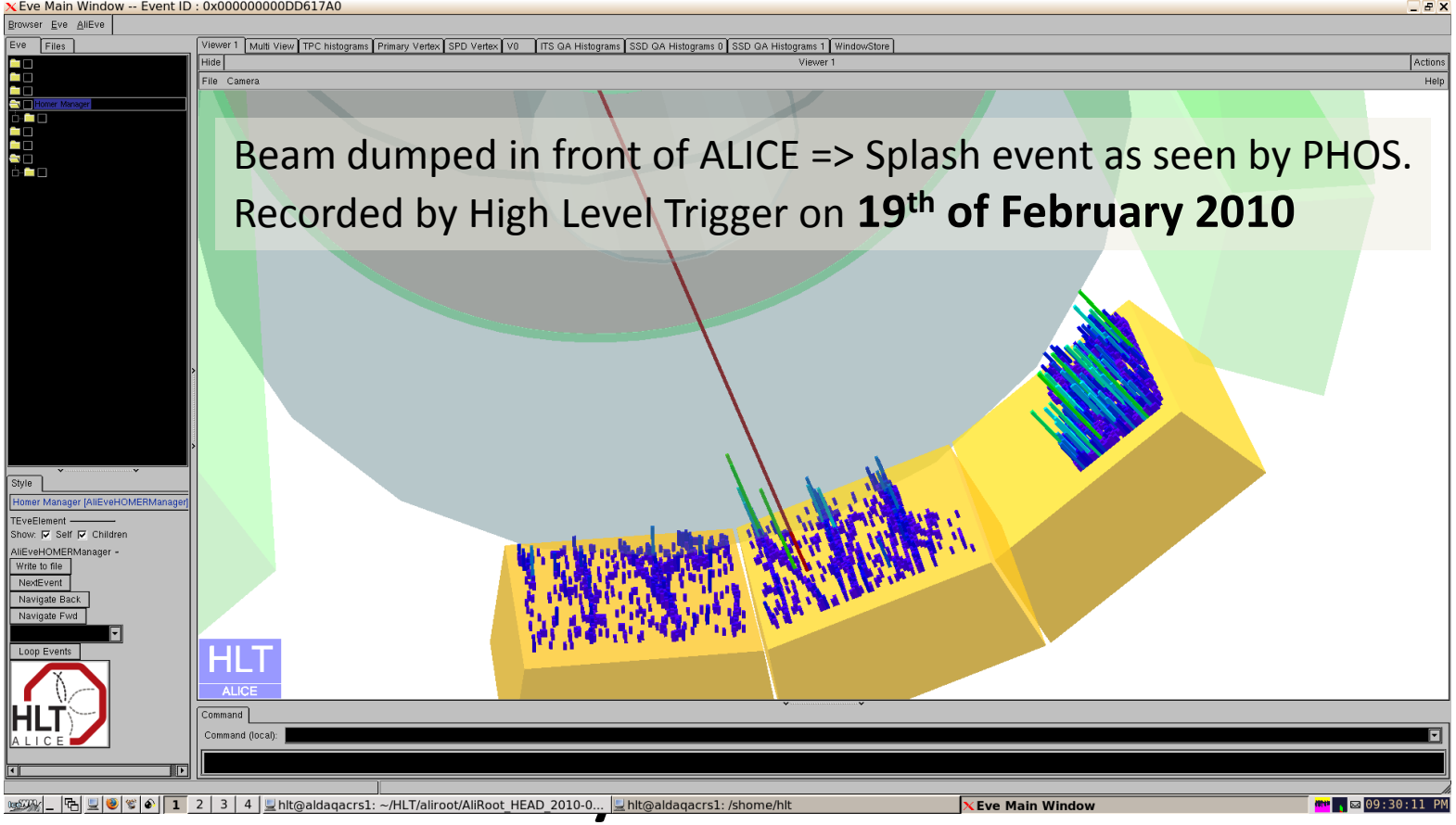


Congratulations to LHC! Looking forward for upcoming Physics runs!

Run 2

- CERN management (Chamonix workshop summary, Jan 29 2010):

  …run the LHC for 18 to 24 months at a collision energy of 7 TeV (3.5 TeV per beam). After that, we'll go into a long shutdown…



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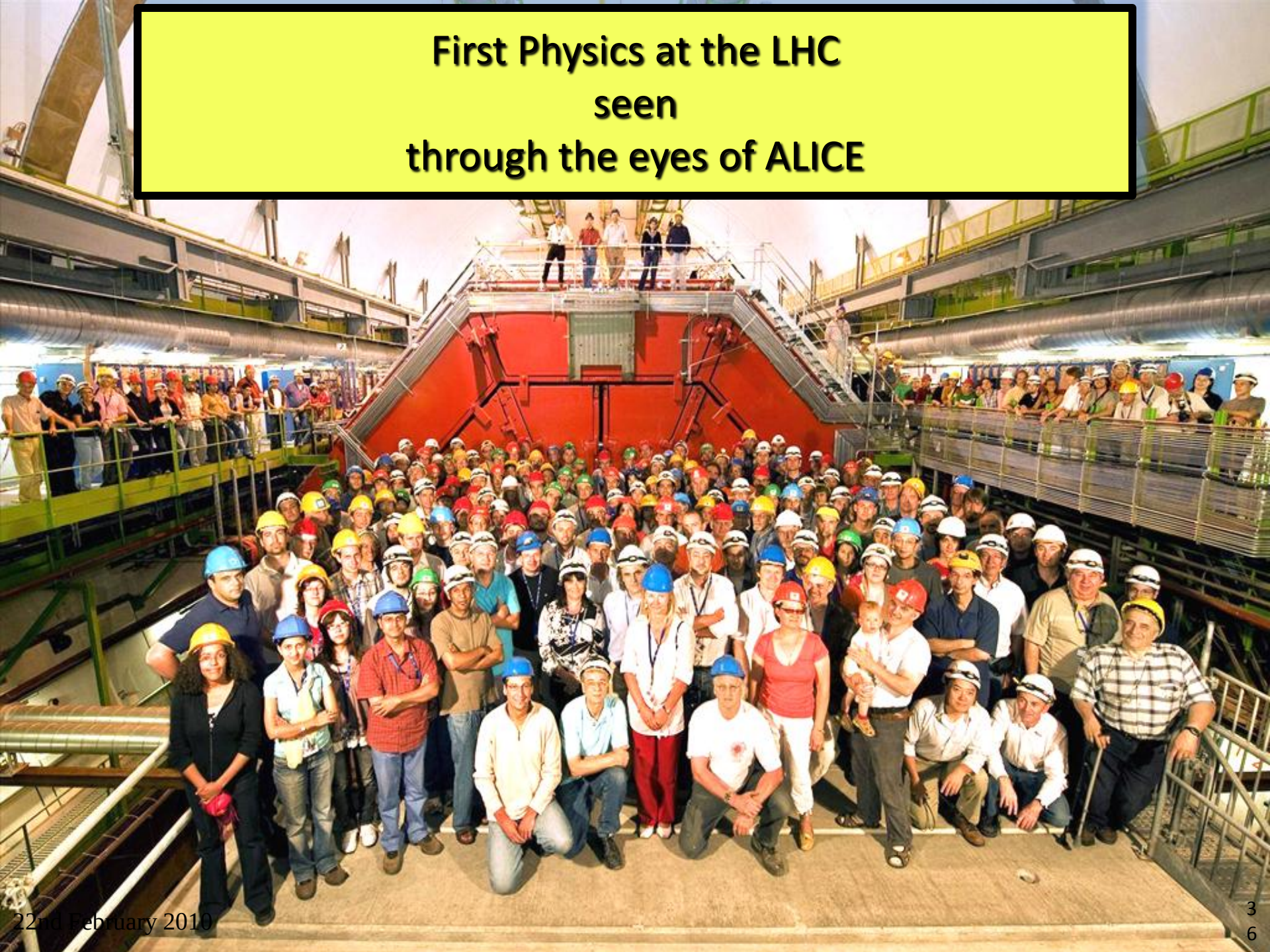
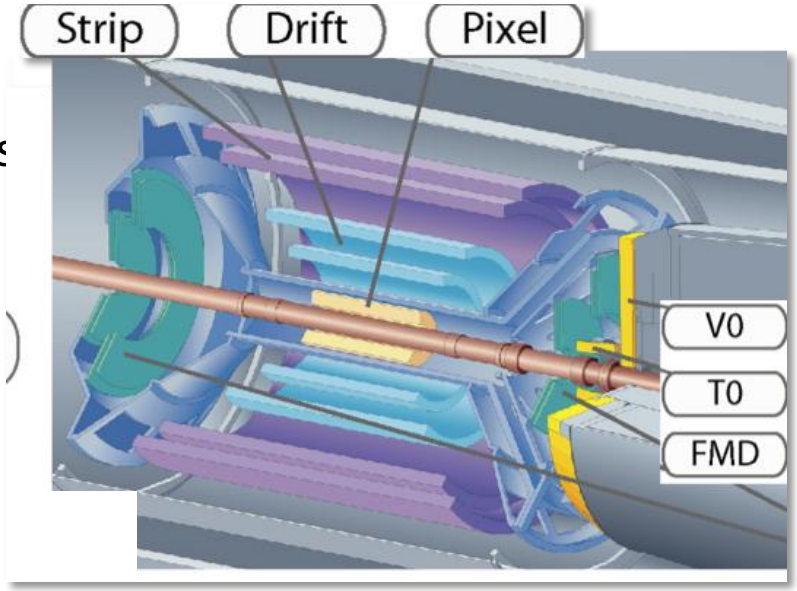
First Physics at the LHC seen through the eyes of ALICE



Extra slides

Inner Tracker System and VZERO

- **SPD (Silicon Pixel Detector)**: two layers (R_1=3.9 cm;$|\eta_1|$<2; and R_2=7.6 cm; $|\eta_2|$<1.4); 9.8 M 50x425 μm^2 pixels; 2.3% X/X_0
- **SDD (Silicon Drift Det.):** two layers (R_1=15 cm and R_2=23.9 cm;$|\eta_{1\text{ and }2}|$<0.9); 260 sensors; 500 V/cm;133 k collection anodes with a pitch of 294 μm; sampled every 50 ns; 2.4 % X/X_0
- **SSD (Silicon Strip Det.)**: two layers (R_1=38 cm and R_2=43 cm;$|\eta_{1\text{ and }2}|$<0.97); 1698 sensors with strip pitch of 95 μm and st. angle of 35 mrad; 2.5 M strips; 2.2% X/X_0
- **VZERO:** two scintillator arrays (32 each); $VZERO_A$ at z=3.3 m ($2.8 < \eta_A < 5.1$); $VZERO_C$ at z=0.9 m ($-3.7 < \eta_C < 1.7$); time resolution < 1ns; response measured within +- 25ns around nominal beam crossing time



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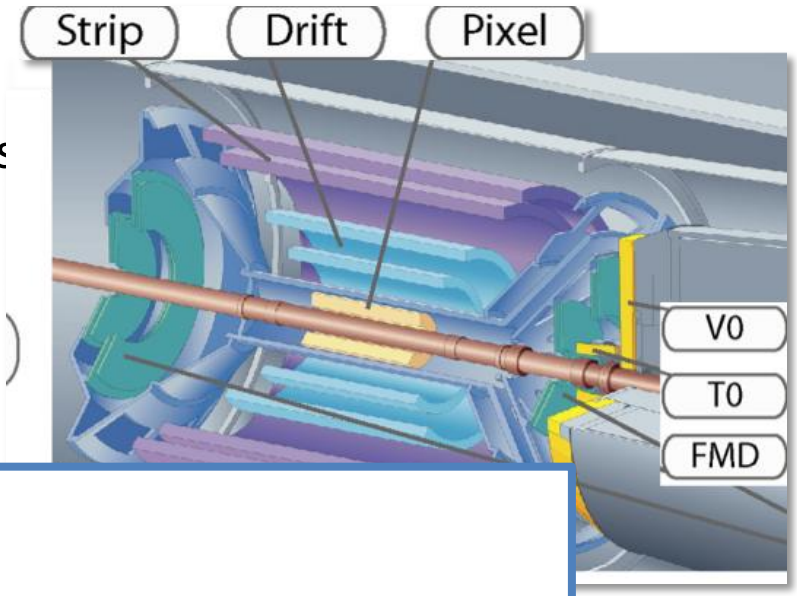
angle of
- **VZERO:**
VZERO$_A$
at z=0.9
< 1ns; re
around



4 Data analysis

The data sample used in the present analysis consists of 284 events recorded without magnetic field. The results presented here are based on the analysis of the SPD data. However, information from the SDD, SSD and VZERO was used to crosscheck the identification and removal of background events.

First (and more…) collision(s) on 23rd of December

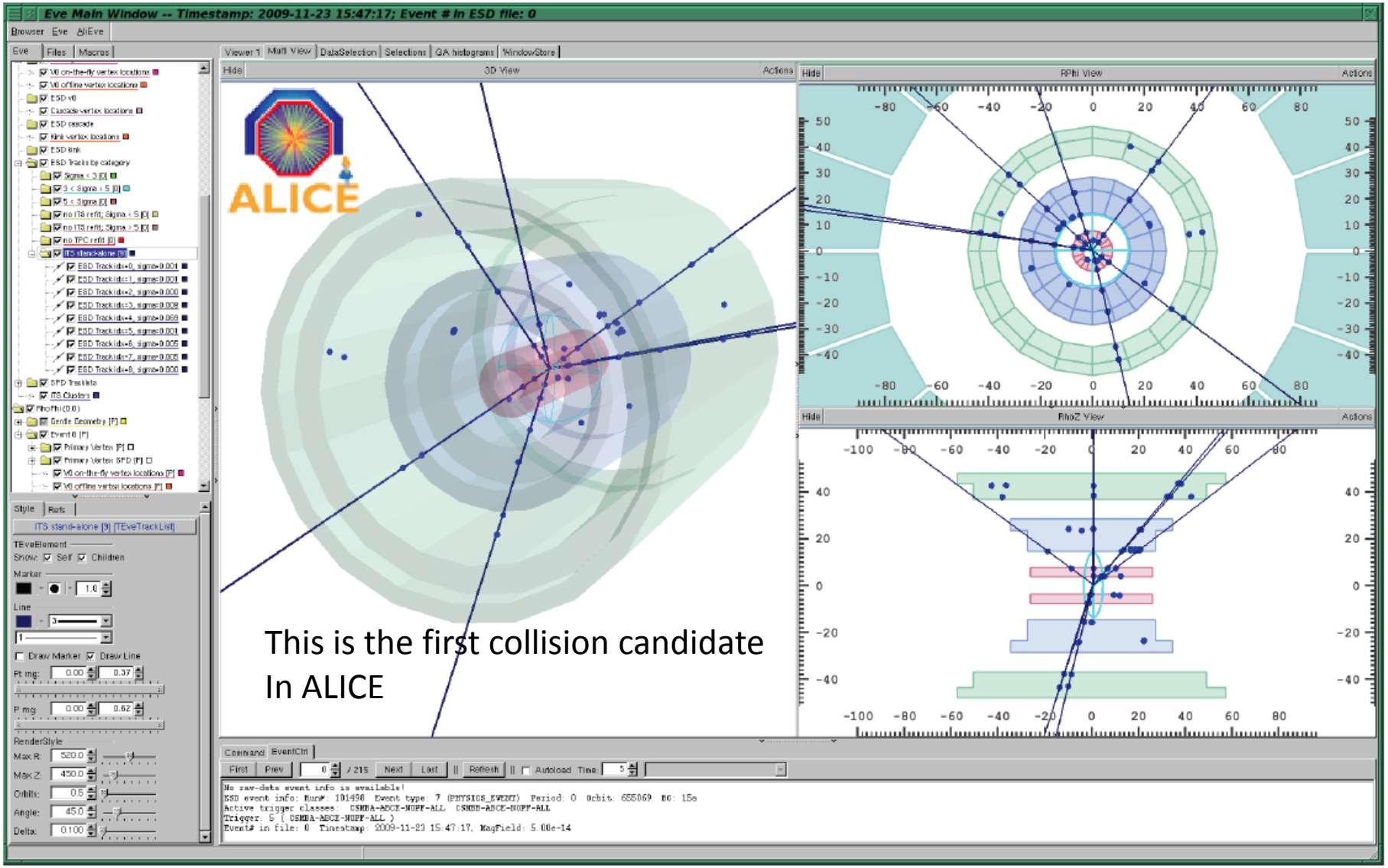


Fig. 1. The first pp collision candidate shown by the event display in the ALICE counting room (3D view, r-ϕ and r-z projections), the dimensions are shown in cm. The dots correspond to hits in the silicon vertex detectors (SPD, SDD and SSD), the lines correspond to tracks reconstructed using loose quality cuts. The ellipse drawn in the middle of the detector surrounds the reconstructed event vertex.

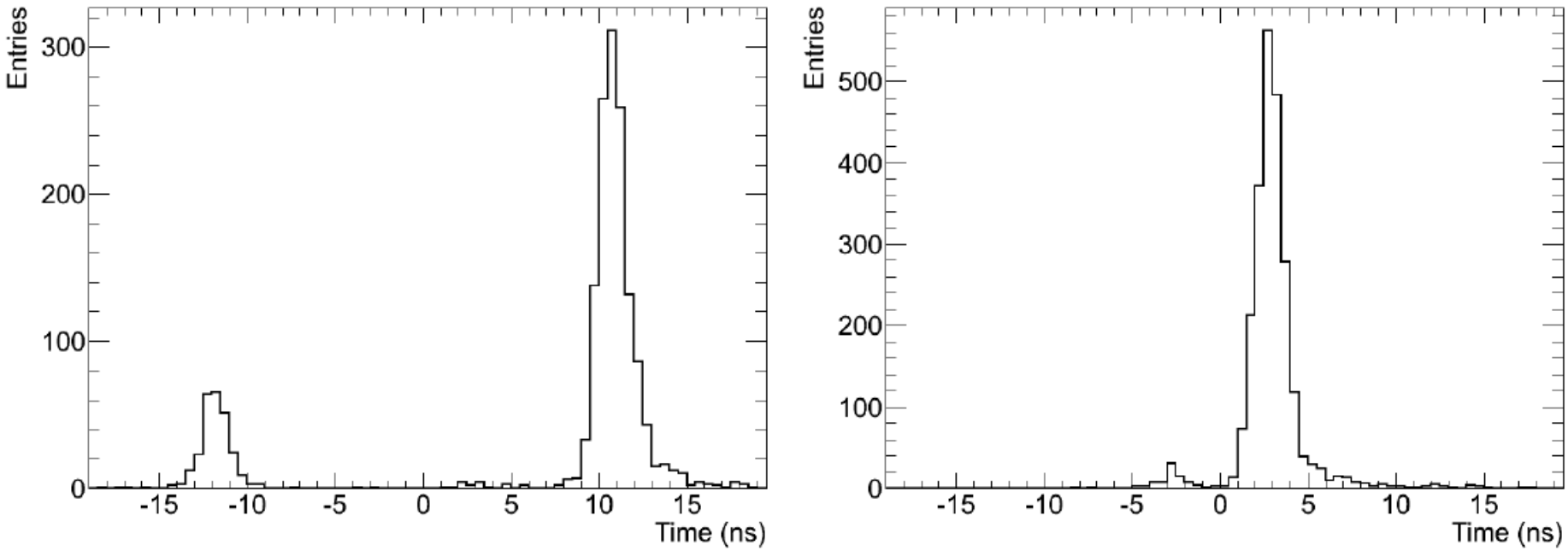


Fig. 3. Arrival time of particles in the VZERO detectors relative to the beam crossing time (time zero). A number of beam-halo or beam–gas events are visible as secondary peaks in VZERO-A (left panel) and VZERO-C (right panel). This is because particles produced in background interactions arrive at earlier times in one or the other of the two counters. The majority of the signals have the correct arrival time expected for collisions around the nominal vertex.

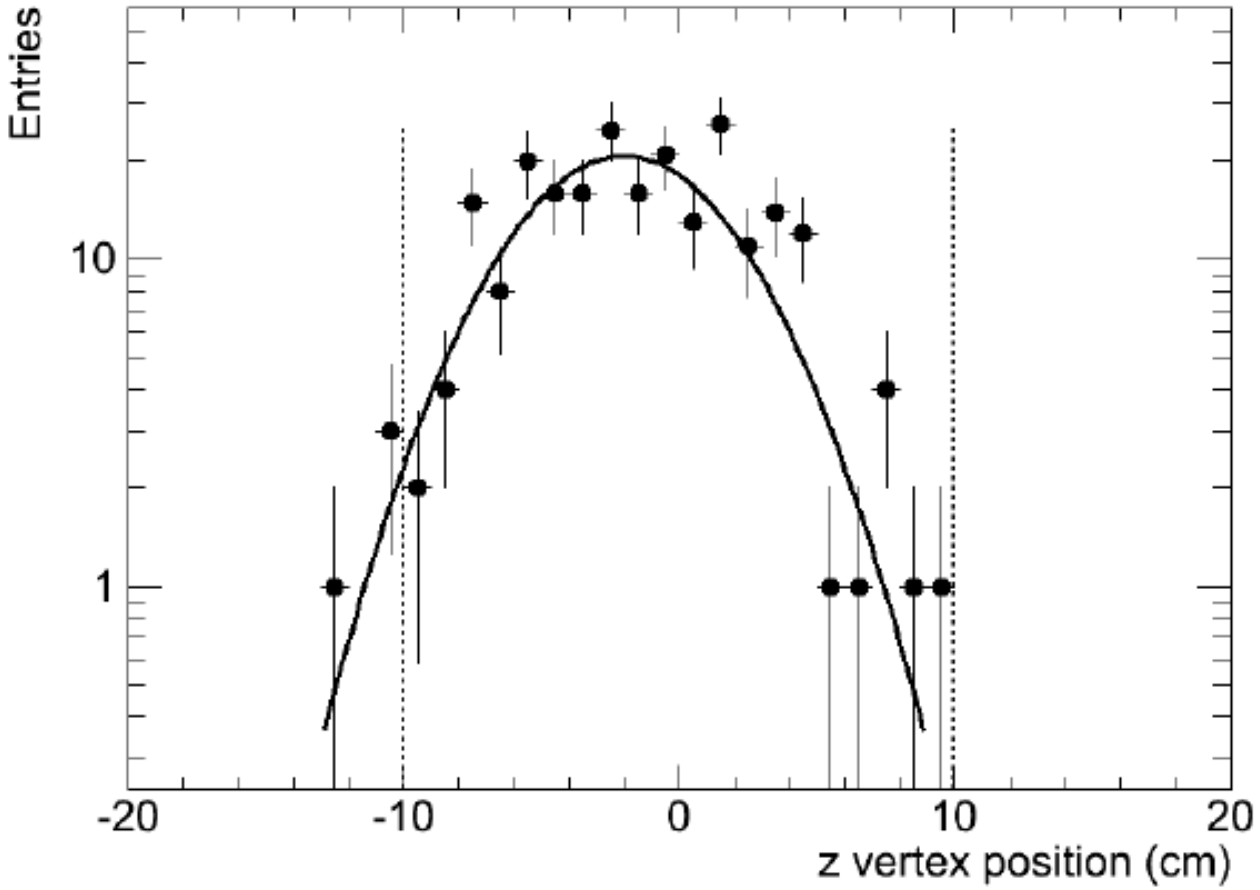


Fig. 4. Longitudinal vertex distribution from hit correlations in the two pixel layers of the ALICE inner tracking system. Vertical dashed lines indicate the region $|z| < 10$ cm, where the events for the present analysis are selected. A Gaussian fit with an estimated r.m.s. of about 4 cm to the central part is also shown.

Table 1. Contributions to systematic uncertainties on the measurement of the charged-particle pseudorapidity density.

Uncertainty	
Tracklet selection cuts	negl.
Material budget	negl.
Misalignment	0.5 %
Particle composition	negl.
Transverse-momentum spectrum	0.5 %
Contribution of diffraction (INEL)	4 %
Contribution of diffraction (NSD)	4.5 %
Event-generator dependence (INEL)	4 %
Event-generator dependence (NSD)	3 %
Detector efficiency	4 %
SPD triggering efficiency	2 %
Background events	negl.
Total (INEL)	7.2 %
Total (NSD)	7.1 %

The number of primary charged particles is estimated by counting the number of tracklets. This number was corrected for:

- trigger inefficiency;
- detector and reconstruction inefficiencies;
- contamination by decay products of long-lived particles (K^0_s, Λ, etc.), gamma conversions and secondary interactions.

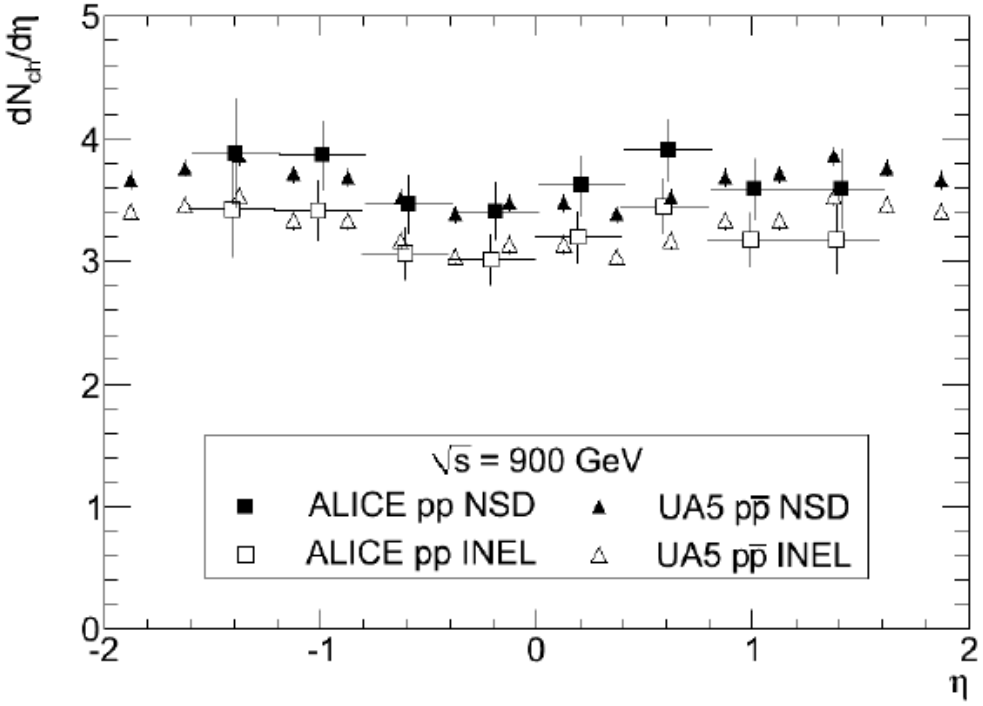


Fig. 6. Pseudorapidity dependence of $dN_{ch}/d\eta$ for INEL and NSD collisions. The ALICE measurements (squares) are compared to UA5 data (triangles) [3]. The errors shown are statistical only.

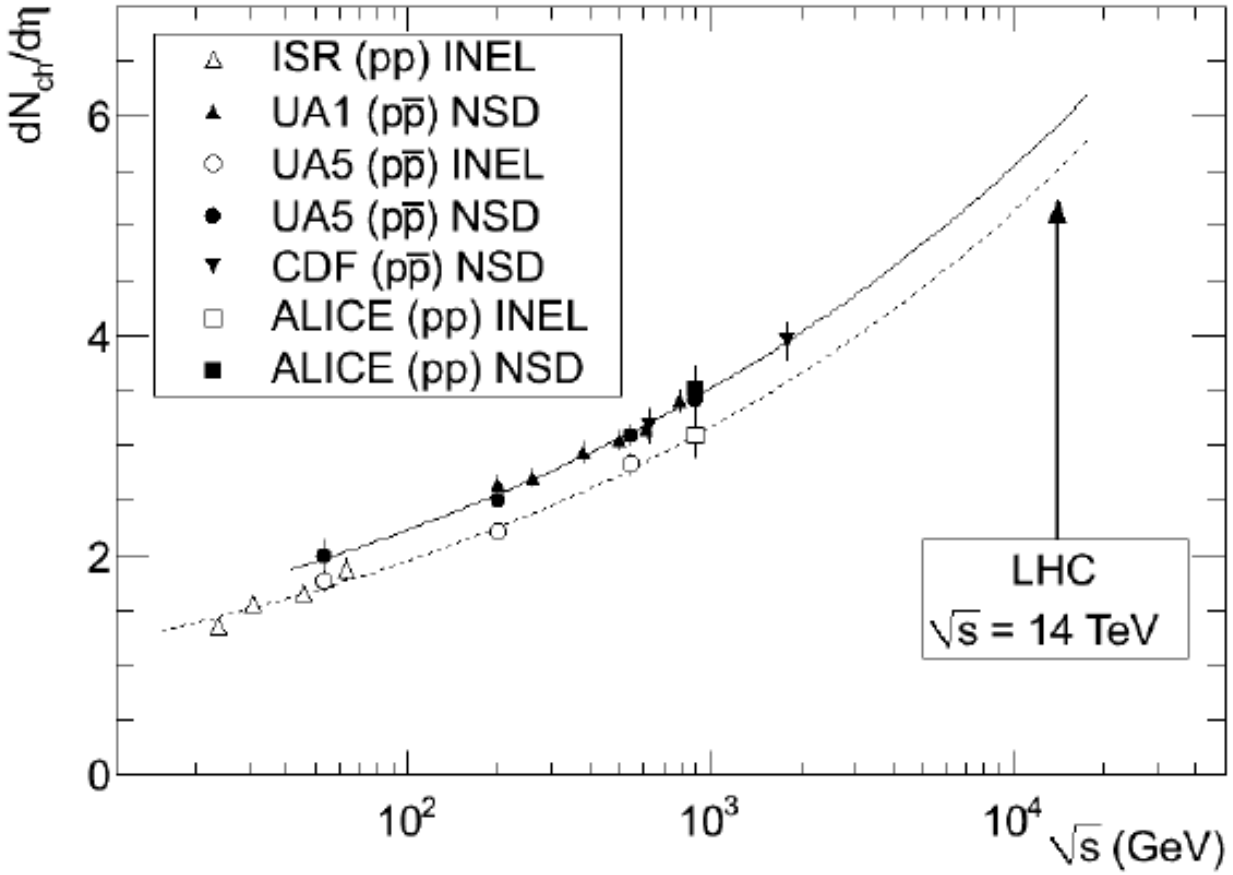


Table 2. Comparison of charged primary particle pseudorapidity densities at central pseudorapidity ($|\eta| < 0.5$) for inelastic (INEL) and non-single diffractive (NSD) collisions measured by ALICE in pp interactions and by UA5 in $p\overline{p}$ interactions [3] at a centre-of-mass energy of 900 GeV. For ALICE, the first error is statistical and the second is systematic; no systematic error is quoted by UA5. The experimental data are also compared to the predictions for pp collisions from different models. For PYTHIA the tune versions are given in parenthesis.

Experiment	ALICE pp	UA5 $p\overline{p}$ [3]	QGSM [26]	PYTHIA [17]			PHOJET [8]
Model				(109) [18]	(306) [27]	(320) [28]	
INEL	$3.10 \pm 0.13 \pm 0.22$	3.09 ± 0.05	2.98	2.33	2.99	2.46	3.14
NSD	$3.51 \pm 0.15 \pm 0.25$	3.43 ± 0.05	3.47	2.83	3.68	3.02	3.61